Untapped, Underrepresented, and Unstoppable: A Qualitative Study of How Peer and Student-Faculty Interactions Shape the Experiences of Black Undergraduate Women in Engineering and Computer Science

A dissertation submitted in partial fulfillment of the requirements
For the degree of Doctor in Education in Educational Leadership

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August 2020
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Acknowledgements

I am honored to take this moment to thank and acknowledge the village of incredible people who have personally and collectively supported me along this rigorous, humbling and transformational journey. These patient and remarkable people include my family, dissertation committee members, doctoral program cohort (aka CC17), and—most importantly—the untapped, underrepresented, and unstoppable Black women in this study whose voices and experiences have remained muted systems of oppression and institutionalized racism, sexism, and misogyny in their ECS fields.

First off, my family and close friends will always remain the rock that anchors me and reminds me to strive to be the best version of myself, even when I felt defeated. To my entire family and close friends—especially Clinique, Cherita, Chayse, Chad, Shera, Vaughn, Auntie Robin, Robert, Yolande, Lauren, and Cherie to name a few—thank you for encouraging, motivating, uplifting, and showering me with love and positivity as I became consumed by the demands and rigor of the doctoral program. Few words can describe how much you all mean to me. You have all been there since the beginning and have remained patient with my lack of availability and focus while I embarked and grew on this journey. I love and owe you everything.

To my dissertation committee, where do I even begin? Dr. Frankie Augustin, I thank you for agreeing to join and support me on this incredible rigorous and exhausting journey. As one of the only Black/Afro Latina on campus, let alone in STEM, I cannot thank you enough for taking the time to be a part of this study. Your voice, perspectives, and experiences helped corroborate my study and confirm that there is so much to be done in the support, care and advancement of Black women in STEM. Learning more about your own racial, gendered, and
cultural experiences in STEM only reinforced the importance this study and elevated the care and respect I have for you. Thank you for standing with me in this journey.

To the unrivaled Dr. Dimpal Jain. Thank you for being the incredible force in my life and in the Educational Leadership and Policy Studies department. As a South Asian American woman, you were one of the few Brown Women of Color in all of my higher education experiences, and honestly, the closest thing to a Black woman. The moment I met you 8 years ago in the master’s (M.A.) program in educational administration at CSUN, was the moment I felt alive, empowered, and encouraged to learn. You taught me about the politics of race, racism, sexism, and the complexities of Critical Race Theory. It was you who helped me envision myself as a Black male leader in higher education. Thank you for your continued care and support, especially during the last three years, and for always making the time for me when I popped into your office unannounced.

To Dr. Nathan Durdella. Few words can express how much I appreciate you. Thank you for the commitment to my dissertation research project and for agreeing to serve as my dissertation committee chair. Thank you believing in me, acknowledging my worth, and instilling in me a work ethic I could have only dreamt bout. Having also met you in M.A. program, I knew the minute I applied to the doctoral program that I wanted to work with you on this transformational journey. I am grateful for your incomparable guidance and unwavering support and thank you for offering your mentorship when I felt untapped, underrepresented, and hardly unstoppable.

I would also like to acknowledge my fellow CC17 cohort family, I love you all more than words can say. To Alex, Beckie, Carmen, Cathy, Chris, Christine, Cindy, Cole, Dario, Helen, Jaime, Jose, Kelly, Patricia, Paulo, Philipa, Rezenet, Reut, Shabnam, Vanessa, and Zach. Thank
you all for this incredible journey of growth and development. Never in a million years would I have ever thought I would be this lucky to be a part of a family, a team—a force. Each and every one of you have a special place in my heart and have taught me so much about myself. I truly believe in divine timing and know that we were all aligned and destined to undergo this incredible journey together. Thank you so much for being the anchor I needed in my life and for being a lifeline whenever feelings of defeat or imposter syndrome knocked incessantly at my door, and for also creating a safe space where we could all be transparent and vulnerable together, especially during a pandemic and racial and political uprising.

Most importantly, though, I would like to thank each and every one of my 11 participants who were vulnerable and powerful enough to share their experiences of underrepresentation, alienation and exclusion, racial and gender oppressions, and more in their ECS journeys. To Amber, Bella, Camille, Cathy, Glory, Keziah, Makasa, Mary, Sawyer, Serena, Zaria, you are all superwomen in my eyes, and I thank you all for sharing your stories that will certainly resonate with and motivate young Black and Brown girls to inspire to be as smart, powerful, and resilient as you.

Lastly, I would like to acknowledge the COVID-19 pandemic on top of the civil unrest, including the Black Lives Matter movement that has been fueled by an endless list of unarmed Black men and women being murdered and gunned down often by white police officers. From the inception of this research study to just about the very end, my dissertation focus was not hindered by or influenced by the pandemic or the pending civil unrest. It was not until after data collection and analysis did these monumental and global shakeups transpire. While they may not have impacted the overall study, these colossal shifts have certainly brought me closer to my research and shaped the way I see myself as a Black, gay male professional in higher education.
With grateful, privileged, and stress-fatigued tears, I thank each and every one of my family, dissertation committee members, CC17 family, and 11 participants in this study from every fabric of my being for helping me to realize and unlock my potential and bring voice to the voiceless. Without them, I would have never realized I too am untapped, underrepresented, and undeniably unstoppable.
Dedication

I dedicate my dissertation to my mother, Yolanda Marie Evans, and father, Samuel Deazell Johnson, who rest peacefully above and instilled in me the importance of love, respect, grace, and the importance of an education. This win and privilege, I dedicate to you. Rest in Power, always.
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Preface

Over the past few decades, the hopes and dreams of resilient Black American, African and African immigrant men and women pursuing academic and professional careers in science, technology, engineering, and mathematics (STEM) in the United States have gradually become a tangible reality. Yet generational systems of oppression and institutional racism, sexism, misogyny, patriarchy, White supremacy, and male privilege have and continue to operate on multiple individual, institutional, and cultural levels that run deep in the fabric of wealth, jobs, housing, healthcare, and education in America. These oppressive systems often tarnish the hopes and dreams of Black women whose lived experiences are racialized and gendered in institutions and structures that exclude, shame, dehumanize, and violate them. Collectively, these systems of oppression and systemic racism, sexism, and misogyny continue to restrain and dissuade Black women and girls early in their educational experiences from pursuing and succeeding in STEM pathways. As a result, STEM is devoid of Black faces—faces belonging to Black women, in particular, who exemplify untapped, underrepresented, and unstoppable resilience, determination, and potential that is missing and lacking in the already competitive global STEM workforce. Thus, the underrepresentation of Black women in STEM—especially in engineering and computer science (ECS) fields, where they make up less than one percent of all degree recipients in the United States (Yoder, 2016)—remains an urgent social justice issue that can be remedied by increasing their representation in these fields and allowing for diverse innovations and perspectives to flourish and impact STEM in new directions.

As a first-generation Black male, I grew up in a low-income, single-parent household and have navigated both undergraduate and postgraduate landscapes. Along the way, I have
experienced both macro and microaggressions that have stuck with me and impacted my life in various ways. Fortunately, I had peer support systems, as well as faculty support (none of color) who I was able to rely on for support and positive reinforcement. Unfortunately, underrepresented Students of Color, especially Black women, experience varying forms of racism and oppression that shape their experiences and not all are fortunate to rely on the same support systems that I had during my educational journey. As an academic advisor for nearly 4 years, I have worked closely with the unsettling low percentage of Black and Brown women students in engineering and computer science (ECS) and recognize that they lack role models who share their intersecting identities and are not often as engaged as some of their peer counterparts. As a doctoral candidate who has experienced various oppressions during his undergraduate years similar to those I found in the literature on Black women’s experiences, on many occasions I too have shared feelings of isolation, low sense of belonging, and nonexistent access to Black faculty mentors and role models. While I share the same racial identity, though, I am aware that my Black male identity, gendered experiences, and gendered system of oppressions varies, too, from women and Women of Color. Therefore, I am personally invested in exploring the experiences of Black undergraduate women in ECS fields and developing an explanatory model to explain how their peer and student-faculty interactions shape their unique experiences hindered by systems of oppression, including racism, sexism, and misogyny in ECS.

Now, as I take a moment to reflect on my transformation emerging from the voices of the Black undergraduate women in this research story, I am able to look back, reflect, and say that I connect—even more now than prior to the study—with their unique stories of underrepresentation, resilience, and perseverance in their academic journeys. I recognize and share feelings of being untapped, underrepresented, and unstoppable. I may not have been
unstoppable in my initial major as a successful screenwriter, but I acknowledge it has manifested in my realignment to pursue a career in education and represent one of the very few Black, queer Persons of Color to earn a doctorate in educational leadership and policy studies, who is now privileged to contribute to the conversation about and action related to Black women’s intersectionality in male-dominated ECS fields.

Furthermore, my study has confirmed what I already knew about the challenges, hardships, adversity, and lack of role models that Black students encounter in education that ultimately stem from deep-rooted systemic racism and institutional oppressions surging throughout the American education system. Through the lack of racial representation and race-gender and gender biases and stereotypes Black men and women encounter, I can finally understand why it is that—after more than 17 years, nearly three college degrees later—I have not once been taught by a single Black male or female faculty member at the college level. Not in the college of arts media and communication or college of education did I ever see or was I ever taught by a single professor who identified as Black. This is a diversity, equity, and inclusion issue in academia that is not an uncommon reality or barrier for most Black men and women students pursuing an American education. The concept of underrepresentation continues in the school of ECS in which I work. Black representation is invisible and nearly non-existent, where over the span of 17 years, I have not seen any real attempt or sense of urgency to look at their hiring practices to determine how they can address explicit and previously addressed lack of faculty diversity. One may not understand the severity of being robbed the opportunity to see, hear, and feel what it looks like to be taught, inspired, and guided by a teacher, educator, professional, and/or role model. However, I am my participants in this research story, who confirm that shared identity is priceless and that systems of oppression and institutional racism,
sexism, and misogyny threaten the very fabric of the American dream that many Black, African, and African immigrant men and women strive for every day.

I often question how Black men and women are supposed to “get ahead” if they are deprived of role models and shared identity. Like the Black women in this study, how can we strive to be excellent if we do not have access to our own version to follow? While we have and continue to emulate and inspire someone else’s versions of success, ultimately, we are left feeling unfulfilled or like an imposter. Thus, I heard and learned about first-hand the positive and negative experiences of Black women in ECS and how systemic oppressions have and continue to hold Black women back and dissuade them from pursuing and achieving meaningful careers in ECS fields. In turn, I have gained a precise understanding of the themes that emerged in this study: (a) a shared sense of alienation, exclusion, and invisibility; (b) racial and gender discrimination; (c) a complex mix of faculty and peer interactions; (d) identity and culture; (e) perseverance and resilience; and (f) student involvement and sense of belonging.
Abstract

Untapped, Underrepresented, and Unstoppable:
A Qualitative Study of How Peer and Student-Faculty Interactions Shape the Experiences of Black Undergraduate Women in Engineering and Computer Science

By

Deazell Johnson

Doctor in Education in Educational Leadership

I know that when an individual Black woman’s consciousness concerning how she understands her everyday life undergoes change, she can become empowered. Such consciousness may stimulate her to embark on a path of personal freedom . . . . If she is lucky enough to meet others who are undergoing similar journeys, she and they can change the world around them. (Collins, 2000, x)

Much can be learned about diversity and peer interactions and support through an examination of the experiences of Black undergraduate women in male-dominated engineering and computer science (ECS) fields. Based on research questions related to Black women’s undergraduate experiences in ECS fields at a large, urban public university and peer support and interactions that shape Black undergraduate women’s experiences in ECS fields, I was able to interpret the experiences of Black undergraduate women in ECS through the lens of Black feminist thought (BFT) and intersectionality. Patterned themes from results revealed that Black
women demonstrated their academic resilience and persistence as they overcame alienation, exclusion, and invisibility in their own majors. These themes also helped uncover existing oppressions that find Black women still “the only Black person” in their classes and their “voices [don’t] matter” when navigating racial and gender discrimination that stems from systems of oppression that exists at the intersection of the race and gender in ECS. Moreover, their academic resilience seen through the lens of BFT and intersectionality revealed that peer and student-faculty interactions have a complex mix of both positive and negative impacts throughout their academic journey. For instance, shared identity with faculty was a salient finding linked to their satisfaction, resilience, and persistence. Results showed that participants felt being taught by a faculty member who shared some form of their identity—race, gender, sexual orientation, and more—empowered them and motivated them to persist. Given their underrepresentation, seeing someone who looks like them in a professional setting and teaching them was something they lacked and felt was needed at Elmwood University. Persistence and resilience were evident in their overall ability to believe in themselves when no one else does, create their own security within themselves, and seek advisors who may not always look like them or share their overlapping identities.
Chapter 1: Introduction

For the past decade, a nationwide push for science, technology, engineering and math (STEM) curricula has driven projections that the STEM workforce will increase by 10 percent between 2010 and 2020 (BLS, 2009; Lockard & Wolf, 2012), yet recent reports suggest that the U.S. government forecasts a shortage of one million skilled STEM professionals by 2020, putting STEM workforce sustainability at risk (Atkinson, 2013; Holdren, Cora, & Suresh, 2013; Norman, 2004). Most notable is the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (2007) and the U.S. Bureau of Labor Statistics (2015), who emphasized a decade ago that troubling issues point to a number of areas, including low undergraduate STEM retention rates and a decline in U.S. students enrolled in STEM graduate school. Dr. Shirley Ann Jackson, a theoretical physicist and the first Black woman to earn a Ph.D. from the Massachusetts Institute of Technology (MIT) in 1973, coined the term “the quiet crisis” (Jackson, 2007) to describe the increasing gap between the nation’s demand for qualified professional engineers and scientists and the shortage of skilled STEM professionals to meet the demand. Jackson argued that the reasons the U.S. has not kept up with the growing demand for STEM talent is because we have failed to prepare underrepresented students from diverse genders and backgrounds with an adequate education in STEM.

Extending Dr. Jackson’s observations, Atkinson (2013) adds that the lack of diverse professionals in STEM is due to the fact that (a) American students are opting for non-STEM majors due to a lack of belonging, underrepresentation, lack of investment, and/or challenging curriculum, (b) colleges and universities are failing to produce half the number of ECS graduates needed to fill those positions, and (c) the U.S. relies too heavily on foreign talent whose H-1B visas are being threatened by current administration. In the end, the shortage of qualified STEM
professionals threatens the nation’s global competitiveness, innovative capacity, and national security. This shortage is an alarming reality, given we need a diverse population of qualified engineers and computer scientists to help is to strengthen our security, create code and software, and design, implement, test, and preserve global systems and products. The field of engineering is vast and requires knowledgeable and qualified STEM professionals to fulfill mechanical engineering, electrical engineering, computer engineering, aerospace engineering, biomedical engineering, and structural engineering to name a few. Additionally, we need computer scientists to run tests and analyze results, write complex algorithms, create programming language, tools, and other methods to improve the interaction between humans and computers.

The increase in projected growth rate of many of these STEM jobs provide an opportunity for the U.S. to step out of its comfort zone, diversify its talent pool, and focus on untapped and underrepresented talent, like Black and Brown Women of Color, to ensure our STEM workforce remains innovative, competitive, and robust for current and future generations. We cannot forget that diversity is a primary feature of a democratic and just society and we must do what we can to ensure that the lack of diversity and underrepresentation of women and racial minorities in ECS does not remain neglected and overlooked or else there will be a real cause for alarm. According to the Committee on Science, Engineering, and Public Policy and Global Affairs (2011), the data on underrepresented minorities in STEM suggest:

While there has been needed progress, there is also reason for continued concern, even alarm. For example, the percentage of our college-educated, nonacademic S&E labor force that is African American increased from 2.6 percent in 1980 to 5.1 percent in 2005, and the percentage that is Hispanic increased from 2.0 percent to 5.2 percent during that period. However, these percentages and the progress they represent remain small and insufficient, as African Americans comprise 11 percent and Hispanics 14 percent of the U.S. civilian labor force, and even higher percentages in the U.S. population. (p. 36)
Given these factors, it is important to look further into the issue of diversity, both in gender and race, as it remains a steadfast issue in the engineering profession (Yoder, 2016). What you will find is that Black, Latinx, Asian American, Native American, and women overall remain underrepresented in these fields in U.S. higher education institutions (Bensimon et al., 2012; Gándara, 2006; Museus & Liverman, 2010; Stern, 2008). For instance, NCES (2018) reports the total fall 2017 enrollment in degree-granting postsecondary institutions for Women of Color as follows: 14.8 percent Black, 20.6 percent Latina, 6.4 percent Asian/Pacific Islander, 0.8 percent American Indian/Alaska Native.

Black women’s underrepresentation in STEM-related fields is surprising considering NCES (2019) reveals they have slowly begun staking their claim as one of the most educated membership groups in America. For instance, the report shows the percentage of Black women pursuing postsecondary degrees in comparison to their race-gender counterparts and reveals how they have begun to outperform other groups in earning college degrees. This is demonstrated in the fact that Black women comprise only 12.7 percent of the female population in the U.S., consistently represent over 50 percent of the Black students earning postsecondary degrees. Thus, we can conclude that, in terms of percentage, Black women in America overtake their White, Latina, Asian American, and Native American counterparts in the educational arena. Yet, despite the fact that Black women are enrolled in and graduating from colleges in higher percentages across racial and gender lines, the National Science Foundation (NCES, 2017) reports telling evidence that Black women are disproportionately underrepresented in these fields, especially in ECS. More specifically, Black women made up 4.2 percent of students in biological sciences, 2.6 percent in computer science, 2.8 percent in physical science, 2.4 percent in mathematics and statistics, and 0.9 percent in engineering (National Science Foundation,
NCES, 2017). These percentages are alarmingly low, which prompts me to uncover their racialized and gendered experiences in ECS and explore how their peer and student-faculty interactions shape their experiences in oppressive systems.

Given the popularity of Margo Lee Shetterly’s 2016 non-fiction book, *Hidden Figures: The American Dream and the Untold Story of the Black Women Who Helped Win the Space Race*, and 2016 film adaptation, *Hidden Figures*, issues of underrepresentation of Black women and Women of Color, racism, and sexism are now in mainstream discourse, giving girls and Women of Color alike tangible, real-life accounts that can inspire them to pursue STEM degrees. The U.S. should take advantage of the book and film’s influence as well as the increase in projected growth rate of STEM jobs to embrace new and untapped potential of deserving Black women and other underrepresented Communities of Color who can diversify and bring fresh new ideas and perspectives to the global STEM market.

Looking more closely at Black students on campus, their representation in engineering has remained stagnant over time. While the National Center for Education Statistics ([NCES], 2016) data reveal the percentage of Black students earning engineering bachelor’s degrees increased by 35 percent between 2011 and 2016, only 4 percent of all bachelor’s degrees awarded in engineering are earned by Black students, which shockingly is a percentage that has remained relative since 1976. Even more shocking is that Black women continue to represent less than one percent of students earning bachelor’s degrees in engineering (Yoder, 2016). From a diversity, access, equity and inclusion perspective, the underrepresentation of Black women in STEM fields only feeds into the marginalization of Black people in the U.S. and emphasizes systems of oppression that hinder their growth, potential, and contributions of Black women in the U.S. There is a myriad of reasons to invest in gradual number of Black and Brown Women
of Color in STEM fields. Even more than framing it as a social justice issue, we have to remember that Black and Brown men and women have been projected to make up 45 percent of America’s public high school graduates beyond 2020 (Prescott & Bransberger, 2012). For that very reason alone, America needs to step up and advance the education, access, and opportunities for Black women and all People of Color in STEM. This allocation of resources will strengthen our economy and ensure we have the best, the brightest, and the most ethnically diverse global workforce to advance and protect our stake in the competitive global economy.

**Statement of the Research Problem**

The underrepresentation of Black men and women mirror that of their representation in higher education, specifically in ECS fields. While the dearth of Black students in ECS is often cited as an essential area for improvement, it is Black women in particular who are even more underrepresented and pursue engineering degrees at much lower rates than Black men. In fact, Slaughter, Tao, and Pearson (2015) reveal that only 26.3 percent of undergraduate engineering degrees were awarded to Black undergraduate women despite the fact that they outnumber men virtually two to one.

Understanding why Black women are underrepresented in engineering requires a great deal of focus and more literature that uncovers their academic social experiences, barriers to their STEM educational attainment, and various forms of oppression that hinder their academic success. There is a relevant gap in the literature that focuses solely on their unique experiences of being Black and a woman in engineering. Of the research that does exist, researchers cite several systemic factors that work against the participation of Black women in engineering (Foor, Walden, & Trytten, 2007; Obiomon, Tickles, Wowo, & Holland-Hunt, 2007). These factors include feelings of isolation, stereotype threat, tokenism, and lack of visible Black role models in engineering who share the same identity. While such factors are not gender-specific
and shared amongst their Black male counterparts and other Women of Color, Maclachlan (1997) posits that Black women experience these barriers at greater frequencies, especially feelings of isolation in industry and academia. For instance, Maclachlan reported that Black women often find themselves to be the only Black student in the classroom or department and are often excluded from social networks and isolated within their own area.

The underrepresentation and exclusion of Black women in STEM reported in the literature is linked to increasing experiences of racism and sexism that Black women in STEM have tolerated over time and this notion can be referred to as “double bind,” “double disadvantage,” and even “double jeopardy” (Malcom, Hall, & Brown, 1976; O’Brien, Blodorn, Adams, Garcia, & Hammer, 2015). Moreover, their double bind is consistent with Obiomon et al. (2007), who attribute their negative experiences to racial visibility where Black women often stand out due their skin color, hair texture and/or style, and body shape. Given these factors, more information about their unique experiences, especially in relation to their peers, is needed in order to better serve them in K-12, higher education, and the STEM workforce.

Within engineering and non-STEM literature, most research combines the experiences with People of Color and women, leaving Black women lost between the two. Moreover, the literature focuses on Black students compared to White students and women compared to men, often failing to address the reality that Black women are at the intersection of being Black and a woman. Indeed, the problem that this study addresses is limited research on the undergraduate student experiences and outcomes at the intersection of being Black and a woman in engineering programs in the U.S. Specifically, this study addresses a lack of research related to Black women’s peer experiences and influence of peer interaction on academic and social outcomes in engineering fields. According to Blake (1999), Black women encounter the challenges of
gendered racism silently, wanting to avoid and resist the “angry Black woman” stereotype—an oppressive stereotype within itself. Framing current and future studies around Black women and their peer experiences help the economy and higher education better align their goals, diversify the U.S. workforce, and lead to more creative and sustainable engineering innovations.

Ultimately, it is critical that colleges and universities in the U.S. not only improve efforts to increase their institutional and peer outreach and support of Black women in engineering, but also academic and social support because Black women bring cultural experiences and community-based backgrounds into a field that remains dominated by White men. To resolve the issue of underrepresentation, it is crucial to dig deeper into the experiences of Black women in engineering academic disciplines and examine how their peer experiences shape experiences and outcomes—satisfaction, persistence, retention, and graduation. Additionally, more qualitative research is required to uncover rich data about their experiences and how institutional and peer support can be strengthened to increase their representation and retention in engineering disciplines.

**Purpose of the Study**

The purpose of this grounded theory study is to explore the experiences of Black undergraduate women enrolled in an ECS degree program. I conducted an initial focus group of 5 Black undergraduate women majoring in an ECS degree program at Elmwood University, followed by 10 personal, one-on-one semi-structured open-ended interviews. Of the 5 who participated in the initial focus group, 4 participants accepted invitations and continued on to the personal, one-one-one interview. I used a concurrent data collection-analysis approach and employed a constant-comparative method in the data analysis process.

Critically examining the experiences of Black women undergraduates majoring in ECS degree programs, I will present stakeholders and institutions of higher education with proactive
strategies and actionable recommendations to develop effective policies, programs, and services that support the representation, well-being, sense of belonging, and academic success of Black women—at entry and through successful graduation—in male-dominated ECS fields.

Ultimately, my initial goal of this study was to develop a theory to determine how peer interactions shape the experiences of Black undergraduate women pursuing undergraduate ECS degree programs at a large, urban public university.

**Research Questions**

The following research questions guided my study:

1) What are Black women’s undergraduate experiences in engineering and computer science (ECS) fields at a large, urban public university?

2) How do peer support and peer interactions shape Black undergraduate women’s experiences in ECS fields?

**Definition of Terms**

The following are several definition of terms used throughout this dissertation study.

**Academic persistence.** Academic persistence is defined as a student’s ability to continue to engage and persevere in academic tasks, despite facing barriers and challenges that thwart path to graduation (Véronneau, Racer, Fosco, & Dishion, 2014; Arnold, 1999).

**Academic resilience.** Academic resilience in this study is defined as the ability and capacity to thrive and succeed academically, despite encountering barriers, hardships, and/or challenging life conditions that may hinder a student’s path to academic success (Wang, Haertel, & Walberg, 1997).

**Black.** NCES (2014) defines the demographic term “Black” as a person or person with any Black African lineage (NCES, 2014). For the purpose of this study, I use this term in dominance to reflect all Black persons. I also use the terms “Black American” or “African American” refers to those who grew up and live in the U.S. and terms like “African” and
“African immigrant” to represent to Blacks who immigrated to America from African populations.

**Peer support and peer interactions.** Generally speaking, peer support and peer interactions are peer-to-peer arrangements where students socially engage and share their experience and encouragement with others to achieve a common goal or academic success. At the college level, many peer support and peer interactions manifest through social engagement in student clubs and organizations, peer mentoring, peer studying, peer tutoring, peer-learning communities, etc.

**Shared identity.** Shared identity in this study focuses on any shared racial, gender, culture, or any identity that is shared between participants and their peers and/or faculty. It has been found that diverse racial and ethnic backgrounds have more positive connections with and perceptions of leader identity when matched up with someone of their race or gender, which can lead to more social engagement and meaningful connections with whom they share some form of identity and a decrease in threat perception (John, Rowley, & Hu, 2009; Rousseau & van der Veen, 2005).

**Undergraduate student.** An undergraduate student, according to the Merriam-Webster (n.d.) is defined as a college student “a student at a college or university who has not received a first and especially a bachelor's degree.”

**Overview of Multi-Theoretical Framework**

In this section, I identify the use of a multi-theoretical framework. Together, BFT and intersectionality (a) inform a rich understanding of the unique experiences of Black undergraduate women in ECS fields and (b) help explore and analyze how peer and student-faculty interactions shape those experiences. Black feminist thought addressed the phenomenon of intersectionality (Crenshaw, 1989), describing how Black women juggle oppressions
stemming from their interacting identities of being both Black and a woman. BFT is a construct used in this study to attest how Black women still remain a key oppressed group in the U.S. (Collins, 2000; Crenshaw, 1997; Davis, 1998; hooks, 1982). In this project, I specifically used BFT to highlight the oppressions Black women face in their pursuit of education in unwelcoming racialized and gendered ECS environments. Ultimately, from a multi-theoretical perspective, these concepts provide a framework that will help reveal the ways in which Black undergraduate women in ECS experience alienation, exclusion, invisibility, racial and gender discrimination, and more against a backdrop of a system of oppression and structural racism, sexism, and misogyny that runs rampant in ECS.

Overview of Methodology

Informed by BFT and intersectionality, I used a grounded theory research tradition to develop a model to explain how peer and student-faculty interactions shape the experiences of Black undergraduate women in an ECS school at large, urban public institutions of higher education. As a methodological framework, grounded theory is ideal for this study because it “structures inquiries so that relationships among factors can explain patterns of social problems” (Durdella, 2018, p. 101). The problem that this study addresses is the phenomenon of underrepresentation of Black undergraduate women in ECS majors and relates to a gap in knowledge of how peer support and faculty interactions shape those unique experiences.

The research setting for this study is an ECS school at a large, comprehensive public university located in California. The campus is designated as a Hispanic Serving Institution (HSI) in that the Latinx student population exceeds 25 percent and is a member of a university system with an enrollment of nearly 40,000 full- and part-time undergraduate and graduate students who come from a diverse mix of ethnic, racial, and gender backgrounds. Based on fall 2018 data obtained from the university at the initial phase of the study, students who identified as
a woman comprised 55 percent of the overall student population, while males made up 45 percent. Of those numbers, the student racial profile consisted of the following: 50 percent Latinx; 20 percent White; 10 percent Asian American; 5 percent International; 5 percent African American/Black; 5 percent Unknown; 2 percent Multi-Race/Other; and less than 1 percent American Indian and Pacific Islander. While the racial profile on campus was nearly identical in ECS, there was an evident gender gap where undergraduate women were significantly underrepresented. Of the 3 percent of Black students in ECS, less than 1 percent identified as women. Thus, sampling Black undergraduate women and exploring how peer and student-faculty interactions shape their experiences helped inform this study and add to the research on their unique experiences based on their multiple identities and underrepresentation in ECS fields.

For the purposes of this study, I used a mixed criterion and snowball sampling strategy to sample Black undergraduate women enrolled in an ECS academic discipline, and I used referrals identified by gatekeepers, informants, and Black undergraduate women in these programs to sample additional participants to interview. In terms of data collection instruments and procedures, I used research invitations, adult informed consent forms, and a semi-structured interview guide with a variety of qualitative interview questions as the main human research participant instruments. My total sample size consisted of 11 Black undergraduate women and for data collection procedures, I conducted an initial one-hour focus group of 5 Black undergraduate women participants, followed 10 individual one-hour, personal semi-structured interviews that were digitally recorded for transcribing purposes. Four of the five who participated in the focus group continued on and participated in the personal interviews. To analyze my data, I followed a constant-comparative method (Glaser & Strauss, 1967) popular to a grounded theory study to help me code, segment, categorize, and thematize the data to help me
develop the theory that positive, welcoming, and equitable peer and student-faculty interactions, plus shared-identity—whether race, gender, and/or culture—with ECS faculty and peers positively influence Black undergraduate women’s motivation, persistence, academic success, and sense of belonging in their ECS academic disciplines.

**Limitations and Delimitations**

As with all research studies, constraints and boundaries exist and helped define the overall scope of a project. Part of addressing the trustworthiness of a research study was to highlight existing limitations of a study. Bloomberg and Volpe (2016) define limitations in a qualitative study as existing factors beyond a researcher’s control that impact or influence the interpretation of the findings. A limitation of this study is the small sample size which may limit the generalizability or transferability of my findings. Given that Black undergraduate women make up less than one percent of the ECS population, their underrepresentation is beyond my control and may generalize my findings. Another limitation includes the selection of a single urban public institution. Of the 23 Black women enrolled in Elmwood University at the time of the study, only 11 responded and participated. Lastly, I am a Black male researcher who comes from a non-STEM background, which is a limitation outside of my control. However, my academic and professional background have provided me opportunities to work closely with women and underrepresented Students of Color as they maneuver educational spaces that lack racial and gender role models on peer, faculty, and administrative levels. I enter the larger conversation about Black women’s racialized and gendered experiences understanding that millions of Black women remain marginalized and stereotyped, experience overt racism and microaggressions, and are disciplined and controlled through coordinated systems of oppression (Brah & Phoenix, 2004). Based on racism and homophobia in my own educational experiences, I share personal feelings and levels of sensitivity for Black women that can possibly bias my own
interpretation of results. Thus, in the researcher roles section, I describe strategies I used to mitigate the effects of who I am as a researcher in the context of this study in more depth.

In contrast to the limitations, which are outside of my control, this project has delimitations, which Glesne (2011) posits are the boundaries a researcher can control and clearly sets to narrow the scope of the study. For my research study, I focused solely on the experiences of Black women enrolled in undergraduate ECS degree program and excluded those enrolled in other STEM programs. Also, focusing on a single urban public institution narrows the scope of inquiry. Ideas for future research include the addition of other higher education institutions as well as Black undergraduate women in other STEM programs to widen the scope of the study and offer additional opportunities to explore how peer and student-faculty interactions shape their experiences in those programs.

**Organization of the Dissertation**

Chapter 1 presents the current phenomenon of the underrepresentation of Black women in STEM fields, especially in engineering and computer science majors in higher education, and highlighted the various forms of oppression which hinder their student success and experiences. This chapter also includes the problem statement, the purpose of the study, and research questions, an overview of the multi-theoretical framework, overview of methodological approach, as well as a discussion of the limitations and delimitations of the study and an organization of the dissertation. Chapter 2 is a review of relevant literature related to Black student experiences in higher education, systems of racial and gender oppression, models focusing in peer support and peer interaction, the underrepresentation and experiences of Black women in racialized and gendered STEM, as well as a discussion of the multi-theoretical framework on BFT and intersectionality and a summary of the literature and statement of the research problem. Chapter 3 contains a comprehensive description of the methodology chosen
for this study. The chapter begins with description of the grounded theory research tradition chosen for this study, the proposed research setting and context, the research data sources and sample, and the data analysis process. Chapter 4 provides the participant demographics and main themes and results that emerge from study as well as the relevant responses from personal, semi-structured interviews and descriptions of data analysis. Lastly, chapter 5 presents the discussion and conclusions, including a chapter summary of the purpose, research questions, methodology, summary of thematic patterns, interpretation of the research questions and results, implications for policy and practice, recommendations for future research, and researcher’s reflection.
Chapter 2: Literature Review

This chapter provides a brief overview of racist, sexist, and misogynistic institutional structures and the racial segregation, poverty, social, and educational issues affecting Black Americans in the U.S. within racialized and gendered systems of oppression, in addition to the experiences of Black undergraduate women in science, technology, engineering, and mathematics (STEM) academic disciplines in higher education. This study highlights Black women because currently, limited research focuses solely on their experiences contributing in these majors compared to research about their Black male counterparts. Often, literature looks at their experiences compared to men or combined with the experiences of Women of Color, never truly uncovering Black women’s unique experiences of their intersecting identities as a Black individual and women while navigating racialized and gendered STEM spaces. The chapter also provides a brief historical account of Black student experiences in higher education and then focused on the general literature regarding the experiences of Women of Color and Black women in STEM. Lastly, the chapter concludes with an examination of various models of peer interactions and how peer interactions and peer support influence the experiences of students in higher education.

Black Student Experiences in Racialized and Gendered Systems in U.S. Higher Education

Recognizing the historical accounts that shaped Black students’ experiences in higher education provides a lens that can help us understand their experiences today. This section discusses Black students’ experiences in higher education prior to and after the 1954 Brown v. Board of Education case and lead into the specific experiences of Black female students in higher education and in STEM fields in particular.
Blacks Students’ Experiences in Higher Education Prior to Brown v. Board of Education

Due to the institution of slavery, access to a formal learning was not a right for the majority of Black people until after the end of the Civil War in 1865. In fact, outside of religious instruction, it was prohibited by law or social policy in the South to teach slaves to read or right and this rule included providing any formal teaching to slaves any formal teaching or write (Hill, 1985). Black men and women quickly saw knowledge and a formal education as a symbol of freedom while Whites were threatened that formally educating slaves to read and write would ultimately lead to upheaval and rebellion (Perry, Steele, & Hilliard, 2003). Soon after the end of slavery in 1865, Blacks were adamant about maintaining their pursuit of a formal education. In 1890, the second Morrill Act of 1890 required states, especially former confederate states, to either grant Blacks access to their predominately White institutions (PWIs) or assign funding for alternative schooling for Black students. Thus, states elected to keep their institutions segregated paving the way for the birth of HBCUs.

Soon after in 1896, the Supreme Court ruled in the Plessy v. Ferguson case that it was legal to operate and maintain racially segregated public facilities. The case supported the enforcement of “Jim Crow” laws, which were laws prohibiting Blacks from sharing the same buses, schools and other public transportation or facilities as whites. It further established the “separate but equal” doctrine to constitutional justify segregation that would persist over the next six decades. As a result of the verdict and increasing racism, the U.S. saw an upsurge in violence and crimes against Black men and women in the U.S. (Thomas, 1981).

Impact of Brown v. Board of Education

While the Supreme Court’s decision in Brown v. Board did not achieve school desegregation on its own, the ruling fueled the emerging civil rights movement in the U.S. The 1954 Supreme Court case, Brown v. Board of Education of Topeka, was a breakthrough of its
kind where the justices unanimously ruled that racial segregation in public schools was unconstitutional and inherently unequal (Gasman & Hilton, 2012). *Brown v. Board of Education* was one of the landmark cases in the civil rights movement that helped reveal the false notion that “separate-but-equal” education and other services were never equal. Notably, *Brown v. Board of Education* overturned the *Plessy v. Ferguson* verdict and remains a pivotal moment in American history regarding the push for the education of Black men and women. However, it is important to note that the Brown decision did not lead to equality as a result for most People of Color and was achieved only to save face amid the Cold War. In fact, according to Jain, Melendez, and Herrera (2020), the Brown decision “had little to do altruism or moral rectitude, but more with how the United States needed to seem morally righteous amid the Cold War” (p. 62).

With the passage of both the Civil Rights Act of 1964 and the Higher Education Act of 1965, Black men and women found expanded access and opportunities to pursue higher education in the U.S. The Civil Rights Act of 1964 was a gamechanger, outlawing discrimination on the basis of race, color, or national origin regarding federally assisted programs and activities. This statute expanded the options of Black students, granting them the opportunity to pursue other institutions rather than rely on HBCUs as their primary option for higher education. For instance, it expanded educational opportunities for Black students, like Shirley Ann Jackson, who earned the title for being the first Black woman to earn a Ph.D. from the Massachusetts Institute of Technology (MIT) and the second to receive a Ph.D. in physics (Sirica, 2003).

Although the opportunity to enroll in desegregated schools was a privilege and an important step in the right direction, the expensive financial burden of education
remained the same. As a result, the Higher Education Act of 1965 was executed as a way to help economically disadvantaged Black students—a function of a historical and then-present-day systems of oppression in slavery and Jim Crow—the chance to attend college, while creating scholarships and low-interest student loans (Gasman & Hilton, 2012). Most notably, the Federal Perkins Loan Program, formally known as the National Defense Student Loan Program, was enacted in 1958 and made it possible for Black students to access financial awards that would allow them to attend college for the first time (Green, 2001). During the mid-1970s, other programs emerged, including the Basic Education Opportunity Program in 1972, which aimed to provide financial assistance to students in postsecondary education and the Equal Education Opportunity Act of 1974 that prohibited racial segregation of Students of Color and forced school districts to reduce barriers to equal access and participation for all students. Emerging from the Higher Education Act of 1965, these programs and those alike sparked a monumental shift in the rise of Black and low-income pursuing higher education, especially at HBCUs (Green, 2001) in the form of Affirmative Action, which in short is a policy designed to provide underrepresented and marginalized groups a more accurate representation within key arenas, like business, education, government.

Black Students’ Experiences After Brown v. Board of Education

After the decision of Brown v. Board of Education in 1954, the number of Black students matriculating at PWIs soared, causing a precipitous decline of students attending HBCUs. For instance, in 1964 nearly 60 percent of all Black undergraduates attended HBCUs, while just under ten years later, those number dropped significantly to nearly 25 percent by 1973 (Allen, 1985). This monumental shift caused changes to institutional and student culture at PWIs, causing Black students to move from being the majority status at HBCUs to minority status at
PWIs. Consequently, and aside from racism and hostile environments, Black students and other Students of Color faced numerous barriers and issues at PWIs, such as the feelings of isolation due to the underrepresentation of Students of Color on campus, difficulty following curricula that focused solely on the Eurocentric beliefs, lack of access to faculty and peers of color, racially segregated student life, and increased racial violence against Blacks on campus (Barlow, 1991).

Ultimately, acknowledging the experiences of Black students at PWIs makes room to understand the unique experiences of Black undergraduate women in White-male dominated STEM environments like engineering and computer science (ECS) fields. First, I focus on systems of racial and gender oppressions, racial segregation, poverty, and social issues affecting Black Americans, followed by the underrepresentation of women, and Black women in particular, in STEM fields. Then, I discuss the early experiences of Black students in higher education and systemic factors that contribute to racist and sexist structures in colleges and universities, more generally, and ECS fields, specifically, that oppress Black undergraduate women.

Systems of Racial and Gender Oppression

Racism as a Part of a System of Oppression

To understand racism as part of a system of oppression, it is important to first define racism and other forms at play. First, racism can be defined as “the actions, attitudes, and institutional policies and practices that subordinate People of Color and simultaneously maintain white hegemony, or the material and ideological advantages exclusive to those racialized as White” (Ali & Buenavista, 2018, p. 17). This discrimination and prejudice towards people based on their race is rooted in historical systems of oppression and instructional racism, sexism, misogyny, patriarchy, White supremacy, and more. Specific to the U.S., American racism, as Ali & Buenavista posit, is explicitly “anti-Black” (p. 17) and a product global colonialism and
manifests in many forms of racism that negatively impact Communities of Color and from other racialized and marginalized groups (Omi & Winant, 2014). These forms of racism include—but are not limited to—individual or interpersonal racism, institutional racism, structural racism, and systemic racism. Collectively, the reflect multiple forms of systems of oppression that Whites, men, and other with power and privilege in STEM and higher education so as to maintain their social, political, and economic status and positions.

**Individual or interpersonal racism.** Individual or interpersonal racism can be described as the type of racism where one’s actions, beliefs, and attitudes of an individual are characterized by race preference, meaning it emphasizes ideological and personal attitudes of racial superiority (Jones & Carter, 1996). This pattern emerges as internalized racism, where all lived experiences by members of society are racialized through the lens of the dominant group, White people, to promote dominant racialized messages that marginalize the subordinated group, People of Color. This can be seen cases where someone has the belief that a particular ethnic group or community is superior or inferior. In this situation, the person can be said to have individual racism. The two types of racism can be compared and contrasted to show how they are interrelated and share common traits in that they both aim to discriminate against another person.

**Institutional racism.** Institutional racism can be understood as the policies and practices rooted within and across institutions that, deliberately or instinctively, lead to outcomes that consistently favor a dominant group or put a racial group at a disadvantage (Socyberty, 2011). Institutional racism also plays a principal role in generating and producing the disparate outcomes and experiences that make up landscape of racial, gender, and other social inequalities. This form of racism is also far reaching and extends into educational system, as well as the housing, economic, prison, and healthcare systems—to name a few. An example of institutional
racism in higher education is through the academic disciplinary policies and procedures that have traditionally targeted and punished Black and Brown Students of Color at much higher rates than their White counterparts. Moreover, it can also include direct hiring policies that prevent People of Color from being present in fields like science, technology, engineering, and mathematics. Pertinent to this study is how the themes of a shared sense of alienation, exclusion, and invisibility, racial and gender discrimination, a complex mix of faculty and peer interactions, identity and culture, perseverance and resilience, and student involvement and sense of belonging all stem from systems of oppression and institutional racism, sexism, and misogyny that contribute to Black undergraduate women’s representation in ECS fields.

**Structural racism.** Structural racism can be seen as a system where policies, practices, representations, and other norms at the public, institutional, and cultural level advance and reinforce racial group inequity and allow privileges associated with “whiteness” and detriments associated with Black and Brown People of Color to grow and strengthen over time. Because structural racism is more of a reflection of the social, economic, and political systems it is less about how once practices this form of racism. For Black women in ECS fields, structural racism is a contributing factor of their lack of representation because educational policies, practices, representations, and other norms in academia continue to reinforce racial and gender inequality.

**Systemic racism.** In some ways, the notions of “systemic racism” and “structural racism” can be thought of as synonymous. Structural racism focuses more on the cultural, historical, psychological, and social facets of a racialized American society. Defined in the introduction of his book, *Systemic Racism: A Theory of Oppression*, Feagin (2006) describes systemic racism:

Encompasses a broad range of white-racist dimensions: the racist ideology, attitudes, emotions, habits, actions, and institutions of whites in this society. Thus, systemic racism
is far more than a matter of racial prejudice and individual bigotry. It is a material, social, and ideological reality that is well-imbedded in major U.S. institutions. (p. 2)

Here, Feagin alludes to how systemic racism is embedded in the very fabric of American society, including education, politics, religion, and the economy and reflected as a socially accepted as the American standard.

**Sexism as a Part of a System of Oppression**

Shifting from race to gender discrimination as part of a system of oppression, the concept of sexism refers to the discrimination or prejudice that centered on an individual’s sex or gender (Masequesmay, 2020). Fueled by misogyny and patriarchy, sexism is a form of bullying, oppression, and domination rooted in the belief that men are inherently superior to women. In her essay, “On Racism,” celebrated Black lesbian science fiction author Octavia Butler (2001) wrote about sexism, positing that “simple peck-order bullying is only the beginning of the kind of hierarchical behavior that can lead to racism, sexism, ethnocentrism, classism and all the other ‘isms’ that cause so much suffering in the world” (p. 1). Here, Butler explains how, like racism and all the other ‘isms’, sexism is a key player in a larger system of oppression and is naturally accepted by society’s hierarchical way of thinking, leading to the violence and suffering of others.

**Misogyny as a Part of a System of Oppression**

Closely related to sexism, misogyny can be defined as the hatred of women or the "hatred, dislike, or mistrust of women, or prejudice against women” (Dictionary.com, 2020). In her book, *Down Girl: The Logic of Misogyny*, author and philosopher, Kate Manne (2018) writes about how misogyny is not just a simple form of hatred towards women, but rather an ideology grounded in the domination and punishment of women who defy power and patriarchy. Connecting it to this study, the reality of misogyny stems from the systems of oppression and
institutional racism, sexism, patriarchy, and the exclusion of women that contribute to the underrepresentation of Black women in undergraduate ECS fields. Manne asserted her view of misogyny as a part of a system of oppressions within social systems or environments where those who are perceived as and identify as women face opposition, hostility, and/or hatred simply because they exist and take up space in a man’s historical patriarchy, or described in the words of a participant, a “boy’s club.” Here, you can see how racism, sexism, and misogyny are all equal parts of Black women’s experience and do not define them as a whole, given that Black women are oppressed in both their race and their gender.

Effects of Institutional and Structural Racism, Sexism Misogyny: Racial Segregation, Poverty, and Social and Educational Issues Affecting Black Americans

Before addressing Black student experiences in U.S. higher education, primarily the unique and complex challenges Black undergraduate women face while simultaneously experiencing issues of racism and sexism in their ECS experiences, and how BFT and intersectionality are used as lenses to understand how systems of oppression and institutional racism, sexism, and misogyny have shaped their experiences in these fields, it is important to highlight issues concerning racial segregation, poverty, and other significant social issues affecting Blacks in the U.S. Moreover, an initial overview of these social issues will help us to better understand how these oppressive systems have negatively contributed to Black undergraduate women’s experiences in ECS fields uncovered in the study: (a) a shared sense of alienation, exclusion, and invisibility, (b) racial and gender discrimination, (c) a complex mix of faculty and peer interactions, (d) identity and culture, (d) perseverance and resilience, and (f) student involvement and sense of belonging.
**Brief Overview of the Intersectional Paradigms of Race, Class, and Nation and Black Political Economy**

Much of the research on the intersectional paradigms of race, class, and nation in explaining Black political economy pointed back the contributions of William E. B. Du Bois, American author, sociologist, and cofounder of the National Association for the Advancement of Colored People (NAACP). Collins (2000) reported on how Du Bois’s work focused less on race and class and more on social hierarchies that shaped Black Americans’ access to education, power, property, and status, to name just a few. He was a firm believer in capitalism, an economic system set up in a manner where private individuals or businesses own capital goods dictated by supply and demand, which fueled the foundation of racism. Moreover, he and many others like him, focused on the power, patriarchy, and White male supremacy of capitalist culture and how it was a direct result of how misogyny and racism used by White American’s created and accumulated vast wealth. Acknowledging and addressing the racial and social issues condemning Black Americans required an intersectional examination of racism “within a context of mutually constructing systems of race, class, and nation” (p. 42). While Du Bois was progressive in his day and recognized that Black American culture was shaped by oppressive and intersecting systems of race, class, and nation, his work did little to advance or acknowledge the dimensions of Black feminist standpoint epistemology that could have shaped and informed a gendered perspective that was needed in Black political economy.

According to Collins (2000), Black women researchers Gilkes (1996) and James (1996) helped fill the gap in Du Bois’s research to help understand “the two dimensions of Black feminist standpoint epistemology that might inform a gendered analysis of Black political economy” (Collins, 2000, p. 43). The first dimension from Gilkes helps us understand the importance of focusing on Black women’s experiences and underscoring the interconnectedness
of collective shared peer group experiences and knowledge, while James posited that we encounter another dimension of Black feminist standpoint epistemology helps us to hone in on the importance of using patterns of intersectionality to interpret, analyze, and speak on social phenomena (Anthias & Yuval-Davis 1992; Collins, 2000). Centering Black women’s experiences produces not only new knowledge but new ways of thinking about such knowledge. Therefore, we will take what we know about the history of Black Americans in higher education and the intersectional patterns of race, gender, class, and Black political economy, to help us understand the true phenomenon of this study, the underrepresentation and experiences of Black women pursuing academic and professional careers in STEM.

The Underrepresentation and Experiences of Black Women in Racialized and Gendered STEM Spaces

Given a nationwide push for STEM curricula in the United States, young girls and women today are getting accustomed to messages that they belong in STEM fields (Shein, 2018). Unfortunately, the new push seems futile as their underrepresentation in these fields remains a worldwide phenomenon (Ceci & Williams, 2011; Cheryan, Ziegler, Montoya, & Jiang, 2017). In the U.S., women fill nearly half of the all jobs in the economy, yet fewer than 30 percent are employed in STEM jobs (National Science Foundation [NSF], 2015). Moreover, NSF reports that women earn 41 percent of PhDs in STEM areas but make up only 28 percent of the total number of tenure-track faculty and are even less represented in full professor positions in these areas. Although ECS jobs are projected to grow 15 to 20 percent through 2020, Shein (2018) predicts the majority of positions will continue to be pursued and filled by men, further reinforcing the shortage of women in these fields. Thus, the shortage of women earning degrees in STEM fields has serious implications for the U.S. economy and negatively influences how many qualified employees enter these fields (Burke & Mattis, 2007; Lehman, 2013; Riegle-
Crumb & King, 2010; Seymour & Hewitt, 1997; Xie & Shauman, 2005). As STEM education and employment declines in the U.S., they are rapidly increasing in other countries. As a result, policy makers believe the decline will only impede America’s economic development and global competitiveness and the lack of qualified STEM professionals will have negative ramifications for national security (Lehman, 2013).

To help understand women’s underrepresentation and non-persistence in STEM fields Morgan, Gelbgiser, and Weeden (2013) use the “pipeline model” as a metaphor to suggest “a relatively rigid, straightforward progression through a fixed set of transition points in educational and occupational careers” (p. 990). The gender makeup of the STEM workforce caters to differences in the way society grooms adolescent men and women as they enter higher education, and the same can be said for the gender differences in attrition and retention rates over time (Alper, 1993). While K-PhD pipeline researchers found no gender differences in interest and achievement in STEM subjects between boys and girls in elementary school, girls and women “leak” from the pipeline as they advance during critical periods in STEM education and other educational pursuits (Bystydzienski & Bird, 2006; Xie & Shauman, 2005). These critical periods, as Pell (1996) suggests, are at the end of graduate school and during early involvement in the workforce. In particular, the two most common factors that contribute to the leaky pipeline include women’s experience with gender discrimination and harassment (Ceci, Williams, & Barnett, 2009; Preston, 2004; Rosser, 2006; Turner, Steward, & Lapan, 2004; Xie & Shauman, 2005). Additionally, scholars explain “chilly climates,” an environment where women are treated as outsiders, is also a feature of the leaky pipeline in higher education (Bystydzienski & Bird, 2006; Colyar, 2008; Dingel, 2006; Kerr & Robinson-Kurpius, 2004; Margolis et al., 2011).
In terms of race and ethnicity, researchers have found that Women of Color have higher rates of attrition in STEM education (Bonous-Hammarth, 2000; Smyth & McArdle, 2004), even though they tend to enter college with a strong interest in STEM majors (Johnson, 2011). Key factors that contribute to their attrition are self-concept (Leslie, McClure, & Oaxaca, 1998), racial and gender discrimination, educational environments that perpetuate negative racial stereotypes, and sense of isolation from White peers and faculty (Ehrhart & Sandler, 1987; Johnson, 2011). These factors parallel Brown’s (2008) findings that Women of Color are scarce in STEM programs, giving them little to no interaction with their own racial group within STEM majors. Johnson (2007) reinforces that Women of Color in STEM majors are often ignored by faculty, subjected to racial stereotyping about their academic capacity, and excluded from participation in class projects and informal study sessions by their White peers. Ultimately, their experiences of racial stereotypes, feelings of isolation, lack of peer interactions, and support from faculty all have negative implications for the access and retention of Women of Color (Brazziel & Brazziel, 2001; Golde, 2005; Herzig, 2002; Taylor & Antony, 2000).

**Early Experiences of Black Women in Racialized and Gendered STEM Spaces**

Examining the contextual influences and socialization experiences most important to the early development of young Black girls, Thomas, Hoxha, and Hacker (2013) employed a grounded theory approach with 17 Black girls and women between 15 and 22 years old both from high school and college across the U.S. They conducted dyadic focus groups in order to increase communication and participation amongst the participants and allowed them to bring along a friend to make them feel more at ease and comfortable and answer questions in a more conversational style that would allow for more thoughtful and meaningful answers. The main findings of the study revealed that peer and familial socialization were both critical in “countering distal influences of stereotypical roles and media messages” (p. 94). They also
indicated that negative classroom experiences acted as barriers toward positive identity development. The findings of this study are important because it sheds light on how self-determination plays a significant role in allowing young women to grow and develop into strong women who can later overcome various oppressions, stereotypes, and microaggressions that were explained earlier in Alexander and Hermann’s (2016) study on peer support and stereotyping as substantial factors that affect the development of Black women.

Regarding stereotypes, Steele, Spencer, and Aronson (2002) noted that stereotypes negatively contribute to their oppression and influence the decision-making process for members of that group. Thus, if young Black girls and Black women view themselves through a negative lens while navigating racialized, gendered, and misogynistic STEM spaces, their actions can mirror their negative perceptions. Peers and teachers have the opportunity to help reinforce positive images and messages about young Black girls. According to Ladson-Billings (1995, 2013, 2014), teachers in the classroom can help them perceive themselves through a positive lens by establishing cultural connections and building positive relationships through embracing culturally responsive and/or culturally relevant pedagogies. This notion is shared by Thomas et al. (2013), who assert that parents play an even more important role than teachers in promoting positive gender and racial identities.

In an attempt to understand the root of gender disparity among men and women in STEM education and careers, Else-Quest, Mineo, and Higgins (2013) conducted a quantitative study to explore math and science attitudes and achievement at the intersection of race and gender among students from ethnically diverse high schools. They sampled 367 tenth grade students from five urban public high schools and created the Philadelphia Adolescent Life Study (PALS) to measure self-concept of ability, expectations of success, math and science achievement. What
they found revealed how younger males continue to report “higher self-concept and greater expectations for success in math and science than female adolescents do . . . whereas female adolescents report greater science value than male adolescents do” (p. 301). Thus, males performed better, but females valued science more. More importantly and most applicable to this study is that related to ethnic differences, Else-Quest et al. (2013) determined that Latinx and Black students were the lowest achieving, while their White and Asian American counterparts reported more positive attitudes and earned higher grades at the end of the year.

Through their study, Else-Quest et al. (2013) offer valuable information regarding the intersection of gender and ethnicity. The study revealed that while young women overall have an interest in STEM, young Black women continue to experience lower achievement compared to their Caucasian and Asian American peers. We understand from other researchers (Alexander & Hermann, 2016; Steele et al., 2012; Thomas et al., 2013) that self-determination, overcoming stereotypical roles, and developing positive gender and racial identities are key to ensuring young Black women develop the tools they need to achieve the level of success of their non-Black counterparts. Furthermore, Griffin (2014) asserts that teachers, parents, and peers have the capacity to promote supportive environments that can nurture young Black students and their interest and achievement in STEM areas.

**Black Undergraduate Women Experiences in Racialized and Gendered STEM Spaces**

In an effort to add more context to the wealth of quantitative data and to address the paucity of qualitative data that exists in the literature about the experiences of Black women in racialized and gendered STEM spaces in education, Alexander and Hermann (2016) conducted a phenomenological study using a qualitative research methodology to examine the personal, social, and academic experiences of eight Black women in STEM graduate programs at a predominantly White institution (PWI) in the South. Using CRT as a framework, the researchers
employed semi-structured interviews and an interview protocol to guide them in their pursuit to gather rich, thick, and descriptive data (Hays & Singh, 2012). Three themes that emerged from the data indicated that participants (a) experienced racial microaggressions, (b) dealt with feelings of low self-efficacy, and (c) received a lack of institutional support during their pursuit of STEM graduate degrees at this particular PWI. In terms or racial microaggressions, participants identified racial stereotyping, invisibility syndrome, and ascription of intelligence to reaffirm messages that “Blacks were not good enough” (p. 313) to be in a STEM graduate program at a PWI. For low-self efficacy, participants expressed diminished academic and low research efficacy as the two main factors that impacted their belief regarding the ability to complete their graduate programs. Lastly, regarding lack of institutional support, participants indicated that lack of peer, faculty, and student services support in the form of research mentors, departmental advisors, and university counseling only contributed to their negative experiences in STEM at a PWI.

Literature regarding the experiences of Black college students at PWIs often exposes narratives of adaptation, negative faculty and peer interactions, cultural barriers, and isolation (Guiffrida & Douthit, 2010; Strayhorn, 2009). Similar to Alexander and Hermann’s (2016) findings, Black students, especially Black women, reported shared feelings of isolation and lack of belonging, as well as negotiating feelings of concealing their academic abilities in fear of being visible and standing out above the rest (Baber, 2012; Griffin, 2006; Terenzini, Yaeger, Bohr, Pascarella, & Nora, 1997). Moreover, negotiating feelings of loneliness during their undergraduate years can have negative effects on their overall undergraduate experience, preventing the likelihood of pursuing potential graduate programs.
Alexander and Hermann’s (2016) findings are important and parallel earlier research that links peer support and stereotyping to the significant factors that affect Black women development (Steele et al., 2002; Thomas et al., 2013). It is interesting to see how from early education all through post-secondary education, most Black women, no matter how hard they work, are impacted by microaggressions and how negative stereotypes continue to hinder their chances of becoming successful in their fields. If the U.S. needs to increase the number of qualified STEM practitioners, more work needs to be done to ensure Black women and other underrepresented minorities have an achievable pathway to succeed from K-12 and beyond.

Using a qualitative study, Borum and Walker (2012) examined the undergraduate and graduate experiences of Black women with doctoral degrees in mathematics. Using a Black feminist framework, the researchers examined twelve Black women who attended a Historically Black College and University (HBCU) versus those enrolled in a non-HBCU. They used purposeful sampling in order to conduct in-depth interviews using open-ended questions as well as various historical documents in order to better assess and supplement interview data. Their main findings revealed that regardless of which school they attended, mentorship, a supportive program, and peer study groups were major indicators that the Black women attributed to their academic success. Unlike Alexander and Hermann’s (2016) sample of Black women who enrolled in STEM graduate programs at PWIs, Borum and Walker suggest Black women that attended a HBCU with smaller class sizes were more likely to experience a more nurturing environment and contributed to them earning their doctorate in mathematics.

Looking as self-efficacy, Chambers, Walpole, and Outlaw (2016) conducted a study investigating the relationship between a student’s self-efficacy in mathematics and postsecondary enrollment for young Black women students. Using the 2002 NCES Educational Longitudinal
Survey, in addition to the 2004 and 2006 follow-up surveys, the author’s sample weighted population nearly 91,000 participants and were exclusive to Black women. Their findings revealed that, for young Black women students, having a higher math self-efficacy was positively linked to enrollment in a four-year institution.

On a negative note, their findings revealed that their math self-efficacy diminished over time and low mathematic self-efficacy had a strong negative link to persistence in a postsecondary institution. More specifically, Chambers et al. (2016) found that of the Black women students in their senior year, “over one-third of students report algebra II as their highest math class, the bare minimum for entering a four-year college, and one-half of students scored in the lowest quartile for math” (p. 308). This finding and others in the study are important as it highlights the underrepresentation of Black women in higher education and contributes to existing documentation of educational inequity.

**Systemic Factors Contributing to Black Women’s Underrepresentation in Racialized and Gendered ECS Fields**

In addition to the above, several researchers cite several systemic factors stemming from both racism and sexism that hinder the engagement and participation of Black women and girls in engineering and computer science fields (Fletcher et al., 2017; Foor et al., 2007; Obiomon et al., 2007). In a timely paper, “Ignored Potential: A Collaborative Road Map for Increasing African-American Women in Engineering,” Fletcher et al. (2017) report about the following systemic factors hinder Black women’s representation and participation in ECS fields: lack of visible role models in ECS, stereotype threat, tokenism, and low feelings of belonging/feelings of isolation.

**Role models in ECS.** Role models are typically acknowledged as a person whose has passion and an ability to inspire. At the college-level, these role models can include peers,
faculty, academic advisors, and administrators, to name a few. According to Fletcher et al. (2017) and Matusovich, Streveler, and Miller (2010), role models are effective in helping students to discover their voice, connect their academic and personal identities to engineering identities, and envision themselves as successful. Engineers/computer scientists. Unfortunately, the severe underrepresentation of Black and Brown women in ECS leaves Black women students fewer opportunities to see themselves as successful in finding someone whom they share one or more of their multiple facets of identity. As long as Black and Brown women continue to remain underrepresented in ECS academic disciplines and career paths, the lack of role models for aspiring engineers will continue. For this reason, a lack of role models remains one of the most significant systemic factors contributing the overall underrepresentation of Black women in ECS fields.

**Stereotype threat.** Stereotype threat is a psychological theory that Steele and Aronson (1995) argue can negatively influence a person’s performance by shifting their attention away from performing a task to worrying about how mistakes and a low performance will confirm any negative stereotypes associated with the group to which they belong. This phenomenon has been found to affect the academic performance of students in a variety of situations, including Black women in ECS fields as the potential underperformance on high cognitive math courses, like calculus, is defined as the anxiety associated with succumbing to or reinforcing negative stereotypes about one’s gender or race from non-Black groups, especially majority groups (Steele, 2010). In other words, stereotype threat can be viewed as a Black woman experiencing fear or anxiety about appearing as the “angry Black woman” stereotype where she may be the only Black face even in that space.
**Tokenism.** Tokenism is a misguided diversity attempt to assimilate a “minority” person—the token—into the majority group, that only ends up singling the out. Historically, this pattern has been observed in systems of oppressions and manifest in racialized and gendered institutions and organizations in the U.S. With respect to stressful environmental factors, Obiomon et al. (2007) found that underrepresentation leads to high visibility and that when Black women are perceived as a token, their behavior and performance is often magnified, exaggerated, and overly scrutinized. For Black undergraduate women in male-dominated STEM environments, especially in ECS, their underrepresentation leaves them highly visible and susceptible to negative judgement and stereotypes based on their race and gender.

**Lack of belonging and/or feelings of isolation.** For decades, several studies have cited that Black women in engineering often experience feelings of isolation and a lack of belonging, (Foer et al., 2007; Geisinger & Raman, 2013; Seymour & Hewitt, 1997). These feelings are often a result of a “fixed mindset” which Dweck and Sorich (1999) describes as the belief that a person either has or does not have an aptitude or ability to achieve something. These feelings are consistent with Hanson’s (2009) findings young Black girls have poor experiences in science and mathematics, leading them to feel isolated, have their confidence and ability in science challenged, and being systematically steered away from away from STEM subjects because of their own fixed mindset. The problem here is that it only makes isolation and exclusion seem like it is their own fault. Given that Black women are still very likely to be the only Black student, faculty, or staff that they see in STEM and are often excluded from social networks, dealing with being the token, coupled with self-doubt, can be stressful and discouraging.

In essence, systemic racism and sexism, prior to and after the era *Brown v. Board of Education*, shape the current experiences of Black women in STEM fields, especially ECS fields.
where they still remain one of the most subjugated and underrepresented groups. Further, racist and sexist institutions are directly linked to the lack of visible and accessible role models in engineering who share their intersecting identities, fears of conforming to negative stereotypes about being a Black woman in academic spaces, pressures of being perceived as a token Black woman and having their performance overly judged and scrutinized, and struggles with low feelings of belonging or isolation in male-dominated engineering environments.

**Peer Interactions of Black Student Experiences in Racialized and Gendered Systems of Oppression in U.S. Higher Education**

Academic ability and high school GPA are a few of the pre-college factors linked to the variance in college student success and achievement (Nelson, Scott, & Bryan, 1984; Pace, 1984; Willingham, Young, & Morris, 1985). However, the experiences students endure while in college also account for how successful a student is during their educational journey. Historically, researchers found that student/faculty interaction, student effort, commitment, and involvement, and more recently, peer interactions have been several factors that consistently emerge as significant influences on student outcomes (Astin, 1996; Ayres & Benet, 1982; Goodsell, Mather, Tinto, Smith, & MacGregor, 1992; Light, 1990; Treisman, 1985; Whit, Edison, Pascarella, Nora, & Terenzini, 1999; Winston & Zimmerman, 2003). Most recently, Moran and Gonyea (2003) reported that of all factors, peer interaction has the strongest “predictive capacity for student outcomes, surpassing, by a considerable extent, the other factors” (p. 14). In other words, the interactions students have with their peers can have a stronger impact on student success and development than student/faculty interaction, student involvement, and student motivation. This argument parallels Astin’s (1993) conclusions that peer interactions during undergraduate years are deemed the most prominent source of influence on student growth and development and is linked to the notion that the peer environment serves
as a central mediating force that influences college student experiences. Lastly, research by Pascarella, Duby, Terenzini, and Iverson (1983) highlighted the importance of peer interactions as a positive influence on academic persistence and perceived intellectual and personal growth and development over two semesters in the first year in college. Some examples of peer interactions include experiences in and outside of the classroom, like peer studying, peer tutoring, student involvement and engagement in various clubs, to name a few.

While peer interactions are found to have positive effects on overall student success, it is important to also understand the role peer interactions and support, like peer mentoring, have on Black female students in higher education. Despite increasing numbers in enrollment, Black undergraduate women students encounter a myriad of challenges like navigating spaces in isolation and a lack of peer influences and support (Banks, 2009; Kao, 2001). The goal of this theme is to explore current research on peer interactions, determine its influences on college students, and understand how they influence Black female students in higher education.

Models Focusing on Peer Interactions

There are various types of in-class and out-of-class peer interactions that occur in college, such as collaborative or cooperative learning, peer studying, peer tutoring, peer mentoring, and involvement in extracurricular activities, like student clubs, organizations, and societies. Regarding Astin’s (1993) Input-Environment-Output (I-E-O) model, the individuals and experiences that students encounter in college serve as elements of the peer environment that affect student growth and/or change. According to Chickering and Reisser (1993), student communities, as well as the friendships and peer support groups students develop in college, influence student development and identity. As a result, peer interactions serve as powerful learning experiences that shape students’ sense of self and identity. This connects with Tinto’s (1993) Student Departure Model (SDM), which suggests peer group interactions and
extracurricular activities, like clubs and organizations, form a supportive social system that fosters student integration. In Weidman’s (1989) model of undergraduate socialization, peer interactions can expose students to “normative pressures” that influence student socialization outcomes. While these models provide insight into how the peer environment and peer interactions influence the student’s development, identity, and social systems, what lacks from these models is how they serve—and help us understand and best support—female-identified students and Students of Color, especially Black women in higher education.

While these models and the support, feedback, and involvement they entail have been argued to be essential to student success and may have positive influences on some students, they have been critiqued for not examining Students of Color. Rendón, Jalomo, and Nora (2000) argue that such models do not extend far enough with regard to underserved students. Additionally, Rendón et al. posit that “these categories are so general, the lack of specificity could hamper a real understanding of what institutions need to do to promote success” (p. 10). Furthermore, peer interactions through involvement and engagement are also important. However, researchers have long since argued that women and other underrepresented and underserved students experience difficulty finding and learning how to get involved (Jalomo, 1995; Rendón, 1994; Nora & Anderson, 2003; Terenzini et al., 1994).

**Influences of Peer Interactions on Student Learning and College Student Outcomes**

Given that current research and student development models posit the peer environment and peer interactions as influential factors in student development it is important to understand the effects peer interactions has on college student development. Ho (2006) summarizes the impact of peer interaction on college student development, framing it around the eight categorizes prescribed in Pascarella and Terenzini’s (2005) four-decade review of more than 1,500 studies that summarize a conceptual framework of student development that links
outcomes to the (a) development of verbal, quantitative, and subject matter competence, (b) cognitive and intellectual development, (c) psychosocial change, (d) attitudes and values, (e) moral development, (f) educational attainment and persistence, (g) career and economic impacts on college, and (h) quality of life after college. Based on the eight outcomes, Ho (2006) links the influence of peer interactions to each outcome and concludes that peer interactions in college can have a positive effect on student’s academic success and college student development. Ho also emphasizes that the higher the quality and extent of those peer interactions, the more it will have on a positive impact on their college student development.

Focusing on student involvement, Astin’s (1993) earlier work reviews the interconnections between student involvement and learning and found that the three most influential forms of student involvement are with academics, faculty, and student peer groups. Astin reveals that the strongest influence on cognitive and emotional development is from a student’s peer group and that the more students engage in peer interaction, the more favorable the outcome (p. 126). Ultimately, this text relates to my study because if Astin’s findings show peer interactions via peer group positively influence students’ cognitive and emotional development, it may help me investigate whether they also shape the experiences of Black undergraduate women in ECS disciplines. However, it important to note that Astin’s theory of involvement is void of and does not consider Women of Color.

Similar to Astin’s (1993) study on the importance of environmental social supports, Dennis, Phinney, and Chuateco (2005) conducted a short-term longitudinal study based on survey and focus group data collected in the fall and the spring of students’ second year in attending college. The study was aimed to investigate the ways in which motivational characteristics and environmental social supports, like peer interactions, contributed to the
academic outcomes of ethnic minority first-generation college students. Motivation to attend college was assessed and participants were asked about the how available their peers and peer network were when encountering college-related issues. Additionally, the environmental social supports that were studied included observations regarding familial and peer support through peer interactions, as well as the perceived lack of needed familial and peer support.

The results of the correlational analyses are similar to past research that links peer interactions and support to college outcomes. For instance, data from focus groups revealed that students perceived peer interactions to be the most influential source of support, especially when dealing with academic-related issues. This corresponds with Astin’s (1993) earlier findings from a large longitudinal study that reveal the most significant predictors of college outcomes were related to peer involvement, faculty involvement, and academic involvement. One limitation of the researcher’s study is that, while longitudinal, it only included two time points: fall and spring. It would be helpful to understand if and how peer interactions and peer support are predictive of outcomes later in their academic journey, including persistence in completing a degree. While the study does identify supportive friends/peers and study groups as their source of peer interactions, Dennis et al. (2005) fall short on exploring other facets of peer interactions, such as peer mentoring or peer tutoring, and if they had higher correlations to the academic outcomes of women and Students of Color. Nevertheless, the researchers do support the notion that peer support and interactions have a positive effect on outcomes such as academic motivation and persistence.

**Peer Interactions and Peer Mentoring in Gendered ECS Fields**

Of all the peer interactions between peer group, peer mentoring appears to have the biggest influence on students’ academic success, growth, and development (Dennehy & Dasgupta, 2017; Kring, 2017; Terrion & Leonard, 2007). Yomtov, Plunkett, Efrat, and Marin
(2017) conducted an evaluation study that aimed to evaluate whether a peer mentoring program would have a positive effect on first-year freshmen experiences. Using a quasi-experimental design with a comparison group, the researchers collected and analyzed pretest and posttest data from 304 freshmen and surveyed one introductory university course that utilized peer mentoring and one without peer mentoring. The results from both quantitative and qualitative revealed that the students who were mentored favored their mentor and felt they were beneficial to their success in the program. For instance, main findings indicated that “at posttest, students with peer mentors reported significantly more integration into the university, felt significantly more active at school, and felt a significantly stronger positive connection to the university” (Yomtov et al., 2017, p. 32). Also, compared to non-mentored students, students who were mentored reported that the interactions with their peer mentors offered them at least one person whom they felt they could rely on for academic and emotional support. While this study adds to the literature on possible benefits of peer mentoring, a limitation of the study was that of the 1,071 students contacted to participate in the survey, only 304 were included in the final sample.

In an effort to determine if peer mentoring has any real underlying benefits for women in engineering, Dennehy and Dasgupta (2017) conducted a multiyear longitudinal field experiment examining if a peer mentoring intervention would increase the academic success of first-year female engineering students. They recruited 150 first-time freshmen women engineering students at a public university and randomly assigned them to either a female or male peer mentor, or no mentor at all, for one year. They surveyed mentees’ experiences and their peer interactions multiple times using online surveys during the intervention year and 1-year post-intervention with the purpose of measuring their sense of belonging in engineering, self-efficacy, feelings of danger, and career goals. Their findings demonstrated that female peer mentors were
significantly more effective than male mentors, or no mentor, in protecting women’s feelings of belonging, motivation, self-efficacy, retention, and post-degree aspirations in engineering. Like Yomtov et al. (2017), the researchers make contributions that advance the knowledge of how peer mentorship promotes peer interactions, while also adding an extra layer that can help close gender-diversity gaps in STEM and lead to student success and retention. Ultimately, the research on peer interactions and peer mentorship relates to my study because my goal is to explore how peer interactions, like peer mentoring, shapes student experiences as well. In addition, it sheds light on how oppressive systems within higher education need to focus on the idea that race and gender matter and more opportunities for women and female mentorship is crucial in these fields.

**Influence of Peer Interactions Among Black Students in Oppressive Systems in Higher Education**

Similar to many studies, the role of peer interactions has been cited as a significant factor in degree attainment for Black students, especially those students enrolled in predominantly White institutions (Bonner, 2003; Brooms & Davis, 2017). Harper’s (2006) findings agree that the peer interactions and support that emerge through peer mentorship is one of the main factors that contribute to degree completion for Black students. Similarly, Bonner’s (2001) phenomenological case study investigated the factors that contributed to the academic success of two high-performing Black male students, one from an HBCU and the other from a traditionally White institution (TWI).

Through a combination of qualitative research methods, Bonner used observations, interviews, and written documents to collect data and employed a grounded theory data analysis to identify critical themes which included: relationships with faculty, peer relationships, family influence and support, factors influencing college selection, self-perception, and institutional
environment. Bonner’s findings reveal that the peer relationships were a vital part of the student’s success and that peer interactions reinforced their academic achievement. Further, Bonner asserts that “peer relationships may expose students to a social network of other achievement-oriented peers, thereby generating and reinforcing higher aspirations and goals” (p. 14). In other words, Black undergraduate women and other students alike can expand their social networks and utilize them for support, which can potentially reduce students’ sense of belonging and isolation. This is critical to the study because it adds to the argument that within systems of oppression and institutional racism, sexism, and misogyny, Black women experience high cases of a shared lack of belonging—if peer relationships can help reinforce aspirations and goals, we need to force higher education to focus on adding more opportunities for Black undergraduate women to develop these “social network of other achievement-oriented peers” as mentioned above. Moreover, Bonner’s findings add to the body of literature and shed light on how peer interactions and relationships can benefit Black students in higher education and within systems not designed for them to succeed. While peer interactions and social engagement in higher education are commonly linked to persistence and degree completion, it is important to note that very little empirical research is dedicated to investigating how they specifically impact Black women in higher education. This issue of a lack of empirical research is salient to this entire study because not only am I adding to their muted conversations in ECS, my work challenges the systems of oppression institutionalized racism, sexism, and misogyny that have prevented opportunities, platforms, and a sense of urgency on Black women’s issues in America.

With regards to peer mentorship, Syed, Azmitia, and Cooper (2011) conducted one of the few studies that highlight the importance of mentors, family, peers, faculty, and student success/services programs for Black women students’ academic success in college.
Furthermore, they posit that peer mentorship helps Black women students as they develop their STEM identities while a lack of services and investment serve as barriers to their advancement (Syed et al., 2011). Since most of studies about Black students focus on Black men, more literature that highlights Black women, specifically regarding peer and student-faculty interactions, is needed to further understand how they influence their experiences in college. Without more studies about Black women and with Black women at the helm of these studies, their voices, experiences, and contributions will continue to be muted and systems of oppression will continue to win. Thus, the purpose of my study focuses solely on Black women and examine how peer and student-faculty interactions shape their experiences in racialized and gendered ECS fields, while also adding to the larger conversation of calling out the oppressive systems that have and continue to perpetuate racism, sexism, and misogyny in these fields.

**Multi-Theoretical Framework**

For the purpose of this study, I employ a multi-theoretical framework, combining both BFT (Collins, 2000) and intersectionality (Crenshaw, 1997) together as lenses to interpret the racialized and gendered experiences of Black undergraduate women in unwelcoming, gendered, and misogynistic ECS environments. BFT serves as a sociohistorical lens to frame how Black undergraduate women in ECS negotiate their intersecting identities and systems of oppressions. Intersectionality allows us to examine participants’ intersectional identities while addressing the broader social and systemic oppressions faced by Black women living with multiple marginalities in the ECS fields. In unison, BFT and intersectionality helped me understand how peer and student-faculty interactions shaped Black undergraduate women’s racialized and gendered experiences in ECS programs, in addition to making suggestion and implications for policy and practice and recommendation for future research that dismantle these systems of racial and gender oppression.
**Black Feminist Thought (BFT)**

The idea of BFT is commonly used to conduct research on behalf of Communities of Color, specifically Black men and women (Prasad, 2005). The concept was fueled by the racial solidarity of the Black Power movement and emerged in the late 1960s, as small groups of Black women joined together as a result of being discounted and abandoned by middle-class, educated White women who emerged out the New Left and anti-Vietnam War movements and eagerly formed their own movement: feminism or White feminism (Breines, 2007). The notion of White feminism centered on the struggles and oppressions of White women without ever addressing distinct forms of macro- and micro-oppressions often faced by Women of Color and women lacking other privileges. Moreover, their fight to challenge male chauvinism, increase equality, and focus on White women’s gender politics—like reproductive rights, personal life, and sexuality issues—failed to recognize the ways in which Women of Color experience sexism and oppression. More importantly, White women’s forms of sexism and oppression vastly differed from the way Women of Color, specifically Black women, experience them. Thus, BFT emerged as a way to challenge the insensitivities of White feminism and aimed to support and inspire Black women to effectively resist multiple oppressions stemming from their race and gender. Now more than ever, it is important to look seriously at the reality of race and gender bias and acknowledge how the two can intersect and produce even more harm.

BFT has also been used because it helps to bridge theory and pedagogy for audiences who rarely have access and exposure to such critical thought and discussions. Collins (2000) asserts that BFT has helped Black women gain visibility through self-initiated exposure of their ideas and experiences accessible to the masses through film, television, books, and various print media—like the previously mentioned book and film adaptation of *Hidden Figures*. More pertinent to and a goal of this research study, hooks (1996) bridges this idea exposing BFT to the
masses by including the experiences of marginalized groups, like Black women in ECS fields, in future social science research to uncover their double bind and shed light on how systemic racism, sexism, misogyny, colonialism, and patriarchy—to name a few—shape, dictate, and shun Black women’s experiences in ECS. More on the idea of providing discourse and a space for their voices to be heard in the community will aid Black women in advancing knowledge about their marginalized experiences in the higher education and the global STEM workforce.

Regarding the oppressive systems at play that hinder Black women’s trajectories into STEM fields, primarily in ECS, I use BFT in this study as a lens to recognize and understand that the position Black women hold in the U.S. is simply a reflection of an oppressive system that has been designed to subjugate them in assigned, subordinate positions. BFT further aids in our acknowledgement and comprehension of how this larger system of oppression works to protect and uphold elite White male patriarchy, power, and privilege, while simultaneously suppressing and negating the concept of Black people as educated intellectuals (Collins, 2000; Crenshaw, 1997; hooks, 1982). I also use BFT to guide us in the reality that no matter how substantively they succeed and/or “break the mold,” Black women can almost guarantee they will find themselves at the center of a double bind where their race, gender, and other overlapping identities are filtered through and challenged by deeply rooted systems of oppressions and institutional racism, sexism, and misogyny that negatively shape their sense of belonging and experiences in often unwelcoming male-dominated ECS environments. Furthermore, these forms of oppression are also attached to Black women’s intersecting or overlapping identities that are, in turn, subjected to various forms of hegemonic oppressions associated with power, patriarchy, and White supremacy.
Intersectionality

A term coined by Critical Race Theorist and Black feminist legal scholar, Kimberlé Crenshaw (1997), intersectionality is defined as “fact that perceived group membership can make people vulnerable to various forms of bias, yet because we are simultaneously members of many groups, our complex identities can shape the specific way we each experience that bias” (Gillborn, 2015, p. 278). In other words, it is a concept that enables us to acknowledge that people simultaneously belong to different membership groups, where complex identities associated with those perceived groups can shape the unique ways in which they each experience and deal with oppression and/or bias. For instance, men and women can experience racism differently, just as Women of Color can experience sexism differently, and so on. In essence, those unique, overlapping identities, are subjected to multiple forms of hegemonic oppressions in the form of racism, sexism, capitalism, patriarchy, White supremacy, and the list goes on (Crenshaw, 1997).

Crenshaw’s (1997) theory of intersectionality did not originate in education; rather, over the course of 30 years, the concept has touched all aspects of social issues. She uses the concept of intersectionality to denote multiple ways in which the intersection of race and gender interrelate to shape the overlapping dimensions of Black women’s experiences in the workplace. She also employs intersectionality to demonstrate how Black women’s experiences are not included within the conventional boundaries of race or gender discrimination and the intersection of racism and sexism directly contributes to Black women’s lived experiences in ways that cannot be fully understood just by framing traditional race or gender dimensions of those experiences separately. Moreover, Crenshaw she has used intersectionality in additional ways in which race and gender interconnect and collectively shape structural, political, and representational aspects of violence against women. Ultimately, we see how intersectionality
can be used in scenarios where a person’s race, gender, culture, or any other identity work in unison to prevent and reduces access to things like education, employment, healthcare, etc. Moreover, intersectionality provides further insight into the interconnectedness of students’ multiple identities and oppressions associated with them.

Given the multiple layers of identity that mark the experiences of many diverse populations, the issues of patriarchy, power, equity, privilege, and discrimination require addressing to provide spaces where students with multiple marginalized identities, like Black women, are present and included. For instance, gender inequalities play a role in the power disparity within majority and racial and ethnic groups (Brown et al., 2007). As a result of intersectionality, these women often find themselves in a double bind (Ong et al., 2011) where they experience unique challenges attached to their race and gender in unwelcoming gendered ECS environments. Brah and Phoenix (2004) contend that intersectionality offers a framework in which race, ethnicity, class and other social differences can be posited as lived realities. As a feminist theory informed by Critical Race Theory (CRT), intersectionality is a theory or method that was designed to help us acknowledge that people identify with and belong to many membership groups, and those unique identities are exposed to various forms of hegemonic oppressions of patriarchy, White supremacy, heterosexuality, and capitalism (Crenshaw, 1997).

Crenshaw (1997) also uses intersectionality as a “prism to see the interactive effects of various forms of discrimination and disempowerment. It looks at the way that racism, many times, interacts with patriarchy, heterosexism, classism, xenophobia—seeing that the overlapping vulnerabilities created by these systems actually create specific kinds of challenges” (Guobadia, 2018, p. 1). Therefore, we can use intersectionality to bring attention to the overlapping forms of oppression and exclusion Black women face in ECS, which is consistent
with the purpose of using both BFT and intersectionality in this study to uncover how various forms of oppression and exclusion contribute to Black women’s double bind in racialized and gendered ECS spaces.

Historically, Black women have remained one of the most socially and economically oppressed groups in the U.S., demonstrating why the concept of BFT is most appropriate for this study and continually important to explore (Collins, 2000; Crenshaw, 1997; Davis, 1998; hooks, 1982). Black women are forced to thrive in a world where their looks, intelligence, and capacity for success are continually challenged, and often ignored or hidden behind the shadows of Black men. Black women must also juggle multiple oppressed and intersecting identities that pose the question of how Black undergraduate women are supposed to succeed in engineering fields with these odds stacked against them. Through a Black feminist perspective, the goal of this study is to explore the experiences of Black undergraduate women in engineering and computer science fields, focusing on how peer and student-faculty interactions shape those experiences.

**Summary of the Literature and Statement of the Research Problem**

From limited literature that focuses on the experiences of Black women in higher education and STEM fields, we know the most intense area of concern is their underrepresentation in such fields, especially ECS, and that their intersectionality brings with them interlocking forms of oppression which may hinder their academic success. Additionally, research supports the notion that peer interactions are the biggest indicators of a student’s academic success and retention and influence their cognitive development, identity development, self-confidence and self-efficacy, and social and academic integration (Pascarella, 1985; Pascarella & Terenzini, 1998, 2005).

Through BFT and intersectionality, we know Black women face multiple oppressions that stem from a system of oppression designed to assign to subservient roles and subordinate
them and also simultaneously belong to other groups or assume complex identities that are oppressed due to the power, patriarchy, and White supremacy that serve as barriers (Crenshaw, 1997). However, there is a gap in the research that uses these frameworks in unison to explain the experiences of Black women in ECS fields in isolation and comparison of Black men and women, especially ECS, and how peer and student-faculty interactions shape their experiences. Thus, my study applied a multi-theoretical framework to explore Black women’s racialized and gendered experiences in ECS based on their multiple identities and to learn more about how their peer and student-faculty interactions shaped the experiences in at a large, urban public university.
Chapter 3: Methodology

The purpose of this grounded theory study is to examine the experiences of Black undergraduate women in an engineering and computer science (ECS) school at a large, urban public institution and uncover how their peer and student-faculty interactions shaped those experiences. The study eventually helped me develop a theory that Black women experience racism, sexism, and misogyny in ECS fields, in addition to a shared sense of alienation, exclusion, and invisibility that stem from systemic oppressions at the intersection of their race and gender. I chose to focus on Black undergraduate women majoring in ECS because they remain an underrepresented population in higher education, especially in STEM fields and a dearth of research has been conducted to explore their experiences as unique from their male counterparts (Harper, 2005). Using BFT and intersectionality as a multi-theoretical framework and a grounded theory research approach, the goal of this study is to fill the relevant gap in the literature related to Black undergraduate women enrolled in ECS degree programs and develop a model to explain how peer and student-faculty interactions shaped their experiences in undergraduate ECS majors.

Research Questions

1) What are Black women’s undergraduate experiences in ECS fields at a large urban public university?

2) How do peer support and peer interactions shape Black undergraduate women’s experiences in ECS fields?

Chapter Organization

I begin the chapter with a discussion of my grounded theory research tradition and how it informs my research purpose, questions, and methods. Next, I describe and justify the selection of my research setting and context. I then follow this up by describing my data sources and explain and justify my sample and sampling strategies. I detail the characteristics of my sample.
and describe how I protected the rights of research subjects. Next, I introduce, describe, and justify my data collection instruments and how they are applicable to a grounded theory methodology. I go on to detail my data collection procedures and describe my data analysis procedures. Next, I describe my researcher roles, articulate my beliefs, biases, and assumptions about my study, and explain how I safeguarded and mitigated issues along the way.

**Research Tradition**

As a study of experiences of Black undergraduate women in an ECS programs—and how peer and student-faculty interactions shape those experiences—I employed a grounded theory research tradition to achieve this goal and it helped develop a substantive theory that derives from and is grounded in qualitative data. Described by the initial developers of grounded theory, Glaser and Strauss (1967) define this research approach as the “discovery of theory from data systematically obtained from social research” (p. 2). The notion of discovering theory that originates from data collected in the field is unique to this research tradition as it “structures inquiries so that relationships among factors can explain patterns of social problems” (Durdella, 2018, p. 101). In this case, grounded theory was deemed best suited to informing my research purpose and answering the questions of my research as they are focused on the experiences of Black women in undergraduate ECS programs and how peer and student-faculty interactions shape those experiences.

Grounded theory focuses on people, processes and/or relationships, and uses guiding principles, like personal and/or semi-structured interviews, observations, and structured journals, to “develop a model to explain the relationships between factors that shape outcomes” (Durdella, 2018, p. 96). In essence, grounded theory sets up data collection and analysis to guide the researcher to employ a flexible set of guidelines that ultimately lead to generating theory based on those factors that shape outcomes and also provides the detailed steps to generate an emerging
theory or idea of how concepts connect to each other and categories associated with codes includes concurrent data collection and analysis, theoretical sampling during data collection, and constant comparative data analysis.

**Research Setting and Context**

The research setting for this study is an ECS school at Elmwood University, a pseudonym for a large, comprehensive public university in California. The campus is designated as a Hispanic Serving Institution (HSI) in that the Latinx student population exceeds 25 percent and is a member of a university system with an enrollment of nearly 40,000 full- and part-time undergraduate and graduate students from a diverse mix of ethnic, racial, and gender backgrounds. Given the short timeframe of this study, I did not select a second site to sample additional participants. In this case, however, the use of a single-site study works well as existing literature and the results of this study confirm Black women’s racialized and gendered experiences in ECS fields.

Based on fall 2018 data obtained from the university, students who identified as women made up 55 percent of the overall student population, while males made up 45 percent. Of those numbers, the student racial profile consisted of the following: 50 percent Latinx; 20 percent White; 10 percent Asian American; 5 percent International; 5 percent African American/Black; 5 percent Unknown; 2 percent Multi-Race/Other; and less than 1 percent American Indian and Pacific Islander. While the racial profile on campus is nearly identical in ECS, there was an evident gender gap where undergraduate women were significantly underrepresented. Of the 3 percent of Black students in ECS, less than 1 percent identified as women. Thus, sampling Black undergraduate women and exploring how peer and student-faculty interactions shape their experiences helped inform this study and added to the research on their underrepresentation in ECS fields.
In selecting Elmwood University, I made sure the university had a well-established ECS program that enrolls a racially diverse group of students. While Black undergraduate women make up less than one percent of the overall ECS student population, their enrollment is relatively high compared to similar universities in the surrounding area. Next, I discuss the importance of my research and explain how research participants benefitted in the study and how this project potentially led to strengthening support for all students.

**Data Sources and Research Sample**

For the purpose of my grounded theory study, I sampled Black undergraduate women majoring in an engineering or computer science degree program at Elmwood University as data sources, used in-depth interviews as my main data collection method, and employed audio-recordings to help facilitate transcribed interview data. Creswell (2007) asserts that “interviews play a central role in the data collection in a grounded theory study” (p. 131). Thus, the intent of interviewing Black undergraduate women and using audio-recordings to transcribe data helped to explore how peer and student-faculty interactions shaped their experiences in ECS.

**Sampling Strategy**

I employed a mixed criterion and snowball sampling strategy to select Black undergraduate women in ECS. As the first step to formal sampling, I used a criterion sampling strategy, layered on top of an intuitive-consultative selection process, which allowed me to sample undergraduate students who identify as a woman, are of Black/African American descent, and are currently enrolled full-time in an engineering or computer science program. This process, as Patton (1990) and Creswell (2008) suggests, avoids generalizing to a population by purposely selecting individuals, settings, events, and processes that help the researcher learn about stories and experiences central to their research problem, research purpose, and research question(s). After initially applying a criterion sampling strategy, I conducted one one-hour
focus group with five participants and use coded data to direct me to additional participants, where new participants were selected and referred to me by participants that fit in the emerging model. As a key element in grounded theory that helped inform participation selection for personal, semi-structured interviews, this process is referred to as theoretical sampling and demonstrated how data is “grounded” in what I did next in the field (Durdella, 2018).

Working with criterion and theoretical sampling, I used a snowball sampling strategy, where I will work with primary data sources, such as research participants, gatekeepers, and/or informants, to identify additional participants appropriate for the study. As Glesne (2011) explains it, a snowball strategy incorporates “knowledge of potential cases from people who know people who meet research interests” (p. 45).

**Sampling Characteristics**

As discussed earlier, literature on Black undergraduate women enrolled in ECS degree programs is extremely limited. However, the small amount of research on the topic of Black women in STEM fields suggests that a significant factor affecting their baccalaureate attainment is linked to their intersectionality, or the systems of oppression and institutional racism, sexism, and misogyny that exists in ECS and how various forms of those oppressions shape their academic experiences. According to Wang and Degol (2013), Black women and other Women of Color experience racist stereotypes and microaggressions regarding their academic ability and competence as well as persisting stigmas regarding their double-minority status (Brown & Leaper, 2010), in which “both their gender and ethnicity are academically devalued” (p. 867). As a result, Aragon and Kose (2007) found that this same population often use their social or cultural capital as a way to use their “network of people and community resources [to] provide instrumental and emotional support” (p. 118) as they navigate academic institutions. Thus, due to the limited research of Black undergraduate women in ECS majors, my goal is to explore how
peer and student-faculty interactions shape experiences of Black undergraduate women in ECS fields.

**Ethical Concerns and Solutions**

According to Durdella (2018), upon entering the field for participant recruitment and data collection, researchers “must have a plan to deal ethically and legally with human subjects in your study” (p. 208), and need to attend to the ethical treatment of research participants early in their work. Therefore, I ensured fairness in distribution through sampling, communicating voluntary participation and confidentially during interaction, and strategizing about data access, storage, and management at final selection.

**Voluntary participation and confidentiality.** I took initial steps to ensure participants were aware that their participation was voluntary by prefacing that my research is in no way, shape, or from related to their university, and that my study would not disclose their personal information to any faculty, staff, administrators or students. Furthermore, I made sure to give an adult informed consent form that clearly stated that their participation was voluntary, and they could freely choose to discontinue their participation at any time during the process.

**Data access, storage, and management.** After receiving information about my participants, I ensured their personal information was kept confidential, inaccessible, and managed solely by me. I also followed Durdella’s (2018) steps to achieve confidentiality and inaccessibility by removing all direct identifiers through use of unidentifiable codes or pseudonyms, storing matching code list and data files in separate locations, and keeping information stored in a password-protected computer or cloud drive.

**Data Collection Instruments**

Using a mixed criterion and snowball sampling strategy, I interviewed Black undergraduate women majoring in ECS at Elmwood University to explore how peer and student-
faculty interactions shape experiences. Thus, I used three human research participant instruments as tools to protect and collect research data: a research invitation, an adult informed consent form, and a semi-structured interview guide.

**Research Invitation**

Upon approval by Elmwood University’s IRB, the fieldwork process began with sending initial research invitations. I recruited sent the research invitations to all research participants introducing myself, describing the nature of my research purpose, and explaining that they have been chosen to voluntarily participate in a dissertation study. The invitation noted that 60-minute semi-structured interviews would be conducted and that a decision to participate or not would not affect their standing at Elmwood University. Lastly, the invitation closed with a statement notifying them that a $5 campus reward card would be provided as compensation upon the completion of the interview. A copy of the research invitation can be found in Appendix A.

**Adult Informed Consent**

Similar to the email invitation, I provided an adult informed consent form to all potential research participants. An important aspect of the adult consent process is confirming that research participants are aware and understand what they are consenting to and where participation starts and ends (Miller & Bell, 2012). Thus, the adult consent form stated the following: participation in the study is voluntary; an explanation of the purpose and rationale of the study; the potential risks and benefits of their participation; procedures to maintain participants’ confidentiality, participation, and withdrawal; how and with whom the raw data was accessed/shared; acknowledgment of audio-recording during the interview process; and the need to document affirmation of the rights of research subjects.
Semi-Structured Interview Guide

I used a semi-structured interview guide that included a brief description of my research study and statement of confidentiality prior to listing focus group and interview questions linked to my research questions. It also reassured participants that their standing in the college and in any class would not be impacted due to their responses.

Data for this study was collected through formal, semi-structured interviews with Black undergraduate women in engineering and/or computer science majors using a multi-question interview guide. Components of the interview guide included a variety of qualitative interview questions that followed a particular a greeting and welcome script. Durdella (2018) stated that with semi-structured interview guides, “a mix of questions, prompts, and topics informs our work but leaves open opportunities to follow hunches and intuitive directions” (p. 220). In other words, I developed additional questions in the field as questions, prompts, and topics that led me to new directions in the conversation.

The interview protocol was used to collect rich data from students and consisted of experience or behavior questions framed as grand or mini tours. Experience or behavior questions, as Durdella (2018) suggests, should come first since they ask interviewees to uncover an event or interaction and form an easy-to-get-to response for most people. I followed up with feeling and probing questions because they can readily connect with earlier questions shared. I also used role-playing as a way to set up a scenario and asked participants to explain how they felt in a particular situation. Durdella suggests role-playing is best used later as it can go in conjunction with feeling, knowledge, and opinion or value questions. Background and demographic questions were asked later, and I ended with an “Any final questions?” inquiry to provide participants with the opportunity to add details they did not have the opportunity to do so earlier. A copy of the interview guide can be found in Appendix C.
Data Collection Procedures

In practice, grounded theory’s procedural reach is unique in that it extends well into data collection and analyses and offers a more prescriptive structure. The process allows the researcher to achieve this by generating an emerging idea or theory of how concepts are connected with one another and categories associated with codes through concurrent data collection and analysis, theoretical sampling through the data collection process, and constant comparative data analysis (Durdella, 2018).

Concurrent Data Collection and Analysis in Grounded Theory

Grounded theory steps away from the traditional recursive process of design, data collection, data analysis, interpretation, and presentation. In fact, grounded theory’s practice of concurrent data collection often finds the researcher conducting data analysis much earlier in the process. For instance, Birks and Mills (2011) describe the process of producing data early in fieldwork and then conducting preliminary data analysis through segmenting, coding, and early thematizing of data collected in the field, to shape what a researcher decides to do next in the field. This process challenges the fluidity of traditional data collection, inserts data collection early in the fieldwork process, and allows the researcher to link concepts to coded segments early in the process so that linked codes are produced and help inform the direction of an emerging theory or model.

Applying Grounded Theory’s Use of Theoretical Sampling to Data Collection

In grounded theory, theoretical sampling facilitates a process of collecting and analyzing data together to direct the researcher to participants who offer successively meaningful data that is directly related to a study. In the words of Glaser and Strauss (1967), this process finds the researcher “jointly” (p. 45) collecting, coding, and analyzing their data and deciding the next step in their data collection process. Following this approach, data was be “grounded” in what I did
in the field when I sampled research participants, conducted a focus group and 10 personal semi-structured interviews, transcribed data, segmented and coded transcribed interview data, and used the emerging patterns from coded data to sample additional participants and informed the development of thematic categories. Specifically, I used coded categories to lead me to sample/select new participants, depending on what emerged, and this practice was done in a series of waves throughout the data collection and analysis process.

**Applying Grounded Theory’s Constant-Comparative Method to Data Collection**

In addition to collecting and analyzing data and using a participant selection strategy guided by coded data, grounded theory also employs a constant-comparative method that involves breaking down the data and merging “segmenting, coding, categorizing, and thematizing with a process of developing an overall theory or explanation about what is happening” (Glaser & Strauss, 1967, p. 102). This iterative process connects with my grounded theory approach, helping me to collect and analyze data applicable to the experiences of Black undergraduate women in ECS majors and allow me to use a constant-comparative method to develop an explanatory model to explain how peer and student-faculty interactions shape their experiences.

**Using Interviews for Data Collection**

In a qualitative grounded theory study, interviews w commonly utilized as a primary data collection method, in addition to focus groups and observations. Using semi-structured interviews, which Glesne (2011) notes, allowed me to “begin with a set of interview questions, remain open to re-forming and adding to those questions throughout the research process, and incorporate impromptu in-depth probes as needed throughout interview sessions” (p. 96). The goal was to conduct roughly 10 to 15 personal semi-structured interviews with current Black undergraduate women in ECS. Durdella (2018) suggested this goal is ideal in applied research
contexts. However, given that this population comprises of less than one percent of the overall student population in ECS, I was limited to 11 total participants in this study.

First, I enlisted the support of the ECS dean and associate dean to recruit Black undergraduate women using criterion sampling strategy. Once identified, I sent the research invitations and adult informed consent forms to each participant and eventually scheduled a time to meet with me in person. The meeting helped me further discuss the purpose of the dissertation study, research proposal, the interview guide, and their voluntary participation and commitment of a 60-minute, personal semi-structured interview that was be digitally recorded and transcribed for data analysis. When the participants provided their verbal consent to voluntarily participate, they were asked to sign and return an adult consent form and received a copy for their records.

During the focus group and 60-minute, personal semi-structured interview process, I recorded using a digital recorder and employed an outside vendor and provided a transcription guide to transcribe the interview data using denaturalized transcriptions, that is, a transcription process that preserves the features of spoken language such as a participant stutters, pauses, etc. I have chosen a denaturalized approach because it is particularly relevant of grounded theory research traditions (Charmaz, 2000) and is consistent with Cameron’s (2001) belief that “within speech are meanings and perceptions that construct our reality” (p. 1274). In order words, preserving the words of my participants is important because I want to ensure I convey their experiences as close as possible to the way they describe it. Once denaturalized transcriptions are complete, I used a member check guide to direct participations in reviewing transcripts, asked participants to reflect on their perspectives, and provided necessary feedback.

In summary, the use of a focus group and personal semi-structured interviews and an interview guide was the most appropriate data collection method for my grounded theory study.
The focus group and semi-structured interviews helped me gather rich data and “develop questions on the spot through dialog in interactions with only the research focus leading the way” (Glesne, 2011, p. 96). Furthermore, utilizing a research invitation, adult informed consent form, semi-structured interview guide, and a variety of qualitative interview questions, such as experience and/or behavior and knowledge questions, helped me to explore how peer and student-faculty interactions shape experiences of Black undergraduate women in ECS academic disciplines.

Data Analysis Procedures

In qualitative research, data analysis is deemed an iterative process that allows researchers to gather and make sense of the data and information they collect in the field (Glesne, 2011). As a centerpiece of this system, Durdella (2018) explains that grounded theory uses strategies to “code, segment, categorize, and thematize data” (p. 267) that is collected and processed. As a result, these strategies collectively form a constant comparative method (Glaser & Strauss, 1967) that prompts a researcher to identify patterns and investigate how coded groups within these patterns are related to a central category.

Applying Grounded Theory’s Constant-Comparative Method to Data Analysis

The data analysis procedure that I used for my grounded theory study follow the constant-comparative method. This approach served as a “dual process of coding and grouping, coding and categorizing, coding and thematizing” (Durdella, 2018, p. 267), all with the goal to distill connections between patterns of data, draw conclusions from the findings, and ultimately develop new theories to decipher the data. In the context of my analytical work for this study, I followed Charmaz’s (2006) two stages of data analysis in grounded theory to delineate the activities involved in the analytical process. The first stage is the initial phase followed up with a
“focused, selective phase where I will use the most significant or frequent initial codes to sort, synthesize, integrate and organize large amounts of data” (p. 46).

**Initial phase.** During the initial phase, my data analysis began as soon as my first focus group was complete and where conducted initial coding where I then was prompted to name each code, line, or segment of data. Moreover, this was where I had several options to work with the data collected, including “word-by-word, line-by-line, and incident-to-incident coding strategies” (Durdella, 2018, p. 268).

**Selective phase.** Next, in the focused, selective phase, I used the most significant initial codes to sort, synthesize, integrate, and consolidate large quantities of data. This process is broken into three stages of coding: open coding, axial coding, and selective coding.

**Open coding.** Once the focus group and first few sets of semi-structured interviews were transcribed by a transcriptionist, and after initial coding was complete, I built on prior comparative coding work and formalize relationships between codes that were originally developed initial coding. Strauss and Corbin (1998, p. 101) explain open coding as “the analytic process through which concepts are identified and their properties and dimensions are discovered in data.” Through open coding, I identified core categories for segmenting and selecting chunks of direct quotes into meaningfully organized units with subcategories.

**Axial coding.** Next, I used axial coding to get closer to understanding how initial codes related to one another and grouped codes by comparing categories to subcategories. Strauss and Corbin (1998) defined axial coding as “the process of relating categories to their subcategories, termed ‘axial’ because coding occurs around the axis of a category, linking categories at the level of the properties and dimensions” (p. 123). In other words, I separated segmented data and
linked categories of codes to subsets of codes that eventually led to a final set of analytical activities, which is also known as selective coding.

**Selective coding.** As a final step, I used selective coding to integrate leading categories and subcategories with each other, where I put narrative themes all together and integrated it all into an explanatory framework. Durdella (2018) describes selective coding as a “confirmatory step in the data analysis process and generally offers [the researcher] an opportunity to check initial, intermediate, and final steps in the process to build [a] model” (p. 269). Furthermore, to assist in the selective coding process, I employed one of Strauss and Corbin’s (1998) suggested techniques, using computer-assisted qualitative data analysis software (CAQDAS), such as ATLAS.ti.

**Summary.** Ultimately, using a constant comparative method as a part of my data analysis offered me an analytic structure to apply as I gathered and made sense of the rich information I collected in the field. In the end, this process helped me to develop a model to explain how peer and student-faculty interactions shape the experiences of Black undergraduate women in ECS academic disciplines.

**Researcher Roles**

Throughout the qualitative research process, the principal researcher and research participants engage in a dynamic, interactive relationship (Glesne, 2011). My prime role as the principal researcher in this grounded theory study is to collect, analyze, and interpret data using a focus group and personal semi-structured interviews to understand how peer and student-faculty interactions shape the experiences of Black undergraduate women in ECS majors.

Additionally, throughout this study I served and served multiple roles, including a current doctoral student enrolled in an educational leadership program, academic advisor, student outreach coordinator, and HSI-STEM support coordinator. As a Black educated male who has
successfully navigated educational pipelines, it is important that I acknowledge my own position and subjectivity (Berger, 2015; Milner, 2016). What I have learned and know about my topic, purpose, questions, and setting stems from experiences in the abovementioned roles and encounters with women and Students of Color in engineering academic disciplines. For instance, in my own profession as an academic advisor, I consistently hear from Students of Color, especially women, that they experience shared feelings of intimidation, lack of belonging in their majors, and difficulty developing meaningful connections with faculty and peers. Ultimately, my academic and professional roles serve as important dimensions of who I am as a graduate student researcher.

**Researcher Bias**

It was my responsibility as the principal researcher to be cognizant of my own assumptions, preconceptions, and biases regarding my research topic, purpose, and questions and understand their effects on my research participants and site. One preconception that I held was the notion that peer support and interactions in fact had positive effects on the Black student population and positively shaped their self-efficacy and academic success. I was also biased in my opinion that the White male-dominated engineering environment had low expectations of Black and other underrepresented Students of Color. Lastly, as a Student of Color myself, I recognized that microaggressions, institutional racism, and gender discrimination remain persistent issues within higher education and negatively impact the academic success of Students of Color.

To remain cognizant of my influence as a researcher, I implemented strategies to reshape my study and avoid my potential bias on my research participants and setting. For instance, in my data collection, I used member checks (Guba & Lincoln, 1989) to account for biases by balancing what I have heard or observed and later return to the site to consult with participants.
and maintain a level of transparency ensure the accuracy of data collected. I also avoided the use of leading questions (Seidman, 2006) during the focus group and interview process and instead asked open-ended questions. In my data analysis, I used data source and method triangulation and/or work with a colleague to help code-recode data.

**Participant Reactivity**

In addition to researcher bias, participant reactivity served as my influence on the setting and my research participants. I ran the risk of disrupting the ongoing social and institutional relationships when sampling, speaking to, and interviewing participants and informants. My role as academic advisor at a similar college campus could have potentially affected the data collection and participants as they may have perceived my role as an advisor—if even not on their campus—to be a position of power and felt less inclined to share personal details about their experiences, possibly out of fear of judgment and/or lack of trust. Additionally, while I am a member of the Black community, I am a Black male, and research suggests that Black women experience life differently due to their intersecting identities of being Black and female. As an educated Black male in a non-STEM field, moreover, my research participants could have perceived me as someone who is privileged and may not have understood what it means to negotiate additional feelings of oppression based on their double-minority status. Lastly, in my data analysis, I used an informant and who shared the same identity as my research participants to help provide feedback on the influence of my study.

In essence, I recognized that my Black male identity, age, academic position, and non-STEM discipline, coupled with my experiences and aspirations differ from those of the research participants. I also recognized I may share some experiences with my participants and understood the importance of being mindful of the participants narratives in order not to minimize my own subjectivity.
Chapter 4: Results

The purpose of this grounded theory study is to report on the experiences of Black undergraduate women in an engineering and computer science (ECS) degree program at a 4-year institution. I designed this study for Black women to share their personal experiences and perceptions in the program and explain how peer support and interactions shaped those experiences. What ensued were documented cases of racism, sexism, and misogyny that all stem from systems of oppression that exist at the unique intersections of Black women’s race and gender. The following research questions were used to guide and inform my study: 1) What are the experiences of Black undergraduate women in an ECS school at a large, urban public institution? 2) How do peer support and interactions shape their experiences?

Using a grounded theory approach to explicitly develop an explanatory form of strategic data collection and meticulous comparative analysis (Glaser & Strauss, 1967), I conducted one focus group of 5 participants and interviewed 10 Black undergraduate women in ECS. The focus group and personal, one-on-one interviews were conducted in a closed conference room setting in the spring of 2020. While this study explored ways in which peer support and interactions shaped the experiences of Black undergraduate women in ECS, a surprising pattern that emerged from participant interviews is that faculty play an equally important role in student experiences, academic success, motivation, and overall feelings of belonging.

Beyond this pattern with faculty uncovered from analytical work, the following six thematic patterns emerged from data analysis: (a) a shared sense of alienation, exclusion, and invisibility, (b) racial and gender discrimination, (c) a complex mix of faculty and peer interactions, (d) identity and culture, (e) perseverance and resilience, and (f) student involvement and sense of belonging. Both positive and negative, these patterned results reveal the inequitable
support and harsh realities Black women face in White male-dominated ECS environments and help explain the systemic factors contributing to their underrepresentation in the field.

These key thematic categories reveal more nuanced results—unique patterns that help explain the mix of Black women’s experiences in ECS and how peer and student-faculty interactions shape their success. With the first thematic category—systemic factors that work against the participation, satisfaction, and success of Black undergraduate women in ECS—major subthemes that emerged were underrepresentation, visibility, unwelcoming culture and climate, a shared sense of isolation, and intersectionality and ECS. For the second thematic category related to faculty and peer interactions, subthemes about faculty interactions included a lack of faculty diversity (race and gender) and an absence of equitable support, while subthemes related to peer interactions included influence of friendship groups, peer-group dynamics, peer and student-faculty interactions, and competition. On the third thematic category—culture and identity—the two emerging subthemes include shared identity and cultural issues (cultural awareness, cultural barriers, and cultural differences).

With the fourth theme, related to racism and racial and gender discrimination, the major subthemes that emerged were racial microaggressions and gender microaggressions. Regarding expressions of academic resilience, the fifth theme in data analysis, the main subthemes included perseverance, self-awareness, self-reliance, sources of support and motivation, and maintaining mental health and wellness. Finally, the sixth theme to emerge from data analysis, academic involvement and engagement, included subthemes about student clubs and organizations and benefits of minoring in Africana Studies.

**Participant Demographics**

As part of the interview process, I screened eligible research participants who identified as a Black/African American woman currently enrolled in an ECS degree program at a large,
urban public institution. First-year undergraduate students with less than two semesters completed at the university were not included because those that were in their first year had yet to take more than one ECS course in their major, and it was crucial to focus solely on their experiences as Black women in ECS courses. In an effort to protect participant confidentiality and ensure they felt as connected to the study as possible, I invited each person to provide a pseudonym of their choice to represent them when presenting research results. The student participant distribution across the five academic disciplines included one student majoring in computer engineering, two in computer science, two in electrical engineering, one in engineering management, two in manufacturing systems engineering management, and two in mechanical engineering. Below, I offer descriptive details of participants co-constructed from interviews and Table 1 reflects the comprehensive participant demographic data.
### Table 1

**Participant Demographic Chart, Spring 2018**

<table>
<thead>
<tr>
<th>Name</th>
<th>Major</th>
<th>Academic Level</th>
<th>Minor (if applicable)</th>
<th>Born</th>
<th>Ethnicity</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amber</td>
<td>Computer Science</td>
<td>Sophomore</td>
<td></td>
<td>U.S.</td>
<td>Black/African</td>
<td>Female</td>
</tr>
<tr>
<td>Bella</td>
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<td>Junior</td>
<td></td>
<td>U.S.</td>
<td>Black/African</td>
<td>Female</td>
</tr>
<tr>
<td>Camille</td>
<td>Engineering Management</td>
<td>Graduate</td>
<td></td>
<td>U.S.</td>
<td>Black/African</td>
<td>Female</td>
</tr>
<tr>
<td>Glory</td>
<td>Electrical Engineering</td>
<td>Junior</td>
<td>Africana Studies</td>
<td>Nigerian</td>
<td>Black/African</td>
<td>Female</td>
</tr>
<tr>
<td>Cathy</td>
<td>Mechanical Engineering</td>
<td>Senior</td>
<td>Physics</td>
<td>U.S.</td>
<td>Black/African</td>
<td>Female</td>
</tr>
<tr>
<td>Keziah</td>
<td>Computer Engineering</td>
<td>Senior</td>
<td>West Africa</td>
<td>Black/African</td>
<td>American</td>
<td>Female</td>
</tr>
<tr>
<td>Makasa</td>
<td>Manufacturing Systems</td>
<td>Senior</td>
<td>Africa</td>
<td>Black/African</td>
<td>American</td>
<td>Female</td>
</tr>
<tr>
<td>Mary</td>
<td>Manufacturing Systems</td>
<td>Senior</td>
<td>U.S.</td>
<td>Black/African</td>
<td>American</td>
<td>Female</td>
</tr>
<tr>
<td>Sawyer</td>
<td>Computer Science</td>
<td>Senior</td>
<td>U.S.</td>
<td>Black/Jamaican</td>
<td>American</td>
<td>Female</td>
</tr>
<tr>
<td>Serena</td>
<td>Mechanical Engineering</td>
<td>Senior</td>
<td>Jamaica</td>
<td>Black/African</td>
<td>American</td>
<td>Female</td>
</tr>
<tr>
<td>Zaria</td>
<td>Electrical Engineering</td>
<td>Junior</td>
<td>U.S.</td>
<td>Black/African</td>
<td>American</td>
<td>Female</td>
</tr>
</tbody>
</table>
Amber

Currently majoring in computer science, Amber is a Black American woman who is a bit shy and reserved yet possesses an inviting smile who can light up any room. She identifies as a pansexual, or someone who rejects the gender binary and has an emotional, romantic, and/or sexual attraction towards another person, irrespective to their sex or gender identity. However, when it comes to home life, Amber revealed she does not freely embrace or identify with her pansexuality at home as she feels she is “not ready or very comfortable with that yet.”

Regarding her passion for computer science, Amber has always had a fascination with technology and was assumed by the thought of family members who deemed her the “go-to” person in the family when a computer was either broken or needed maintenance. The possibility that she too could be a computer scientist grew as she watched and admired her father complete computer programming and coding classes at the local community college and listened to friends and family members who encouraged her to consider the field. Lastly, Amber admitted that prior to attending Elmwood University, she was stuck in the realization that she may not pursue an education post-high school. “I didn’t think I was going to college,” Amber admitted, “and even though I was in AVID in high school they kept saying that we were supposed to go to UCs, and like Harvard and any college is a possibility.”

Bella

Standing tall, with an athletic build and friendly demeanor, Bella is a computer science major junior who has a passion for computer science and developing apps and additional areas within engineering. She initially thought she would pursue a major that was more “hardware-focused” but as grew gained experience through multiple computer science programming and coding camps/programs. Prior to college, she partook in a STEM program that was centered around recruiting and encouraging more Students of Color and those from low-income families
to attend college and pursue STEM degree. She recalls loving that part of her life because she was able to help and work with other people who share her identity to pursue fields, she is passionate about. Making the transition to Elmwood University reinforced to her what she already knew about computer science but was still shocked to see—that the major was more dominated by White males than she had anticipated. Feeling like an outsider at times, Bella admits that she has contemplated changing her major on many occasions. For now, though, she plans to stick with it and continue on with her journey of becoming a Black female computer scientist.

**Camille**

A current graduate student in engineering management, Camille was born in the U.S. During her high school experiences, she did not know much about the engineering field. She recalled that although most of her privileged friends did not know about these majors, they had early experiences that prepped them to be successful for these majors. She explained, “You hear these stories from your classmates where they’re letting you know, ‘Oh, my dad’s an engineer.’ Or, ‘Oh, my uncle gave me an internship last summer.’ And you’re like, I’ve never met an engineer before.” Additionally, she never recognized that there was “this whole engineering community and [that] I had no idea about it.” Thankfully her passions led her to pursuing an undergraduate degree in civil engineering, where she blatantly recalled having professors who made it known they were unhappy to see a Black woman in the field, even as far as to say they do not belong doing “dirty jobs.” She takes pride in being one of the few Black women—out of a sea of engineers—recently serving a position as a junior civil engineer who oversaw consultant and construction design work. Camille was chosen as part of this study because she was the only Black woman graduate student and it was important to uncover her experiences as well. While
she is a graduate student and not undergraduate, she was still able to share similar racialized and
gendered experiences that have shaped her resiliency and perseverance.

**Cathy**

Identifying as a Black woman, or “multiracial on some forms or documents,” Cathy is a
senior majoring in mechanical engineering and pursuing a minor in physics. Never knowing her
biological parents—an African father and Korean mother—Cathy grew up with her adoptive
parents in Los Angeles, California and attended an all-female high school where she was
surrounded and encouraged by female empowerment. She is bright, energetic, and a natural-
born leader in her field. Not only is she heavily involved in student clubs and organizations,
such as the American Society of Civil Engineers (ASCE), NSBE, and SWE, Cathy has also
served as board members for each for multiple years, while also serving on additional
committees and leadership roles on campus. In class group settings, she often finds herself the
leader and “usually takes the lead on those or it just naturally” falls to her. Cathy credits her
academics, diligence, and persistence to her adoptive parents who have instilled in her the will to
succeed. Heavily involved in student clubs and organizations, Cathy takes pride in her continued
involvement on campus. She explained that she participated so much not simply to be involved
for herself, but also on behalf of other students. Cathy explained that her parents instilled in her
this passion to help others and that desire grew after a friend once told her that “in her family, if
one person goes up, they bring another person up along with them.” Together, Cathy believes
those are her motivation and guiding mantra to succeed in ECS—an environment she is well-
aware is male-dominated, competitive, and unwelcoming at times for women, especially Black
women.
Glory

Glory is a friendly and energetic junior majoring in electrical engineering as well as minoring in Africana studies. Born and raised in South Los Angeles, California, Glory identifies as a Black woman at the intersection of two cultures. With a smile, Glory revealed, “I am African and I’m also Nigerian. I was born and raised in Nigerian culture, so I honestly consider myself as the actual definition of African American.” According to Glory, however, it can be complicated at times because “I am African when I go home—we eat African food, right. But I am also American and when I go back to Nigeria, I’m not all—they consider me the “white girl.” She attended a predominately Black high school in a predominately White neighborhood, which at times felt strange but ideal because her peers and teachers were predominately Black and motivated her to succeed. Glory is also a student mentor for the college’s mentorship office and enjoys developing her academic and professional leadership.

Keziah

At the time of the study, Keziah was a junior majoring in computer engineering. She identifies as a Black woman and credits her passion for computer engineering to her father who is a successful computer engineer and always encouraged her to achieve her dreams, no matter how high. Inspired by his work, Keziah knew deep down that she wanted to make him proud and follow in his footsteps—despite acknowledging the racial and gender disparities in the field. Additionally, Keziah’s practice and exposure to programming and coding came early when she enrolled in “a few computer science programming courses in high school and since then I just realized that was something I wanted to do, I did not know the difference between computer science and computer engineering, so when I got to Elmwood University, I realized that it’s kind of like the best of both worlds.
Makasa

Makasa is a mildly shy, yet extroverted senior majoring in manufacturing systems engineering. An immigrant from Africa, Makasa spoke with a soft African accent and often explained to others who inquired where she’s from that she’s “an indigenous African” and simply identifies or looks at herself as just Black. She admits that her peer and student-faculty interactions have been limited when it comes to peers within ECS but that never stopped her from persisting and achieving her goals. She recalled growing up as “an introverted type of person” who mostly played with her brother back home in Africa. “While the other girls made dolls out of clay,” she recalled, “my bother and I made cars out of scattered things.” Makasa noted that she always felt different than her peers and always aimed for more. Even though she did not have the opportunity to pursue engineering back home in Africa, she always knew in her heart that she would pursue a challenging field and is happy that she chose to pursue manufacturing systems engineering as her field.

Mary

Standing stall, with a silent grace and friendly smile, Mary is a senior in manufacturing systems engineering and identifies as a “Single Black Mother,” a stereotype she feels has played a part in her educational experiences and serves as her motivation to persist and succeed. She attended a STEM magnet high school, where she partook in VEX robotics challenges feels is where she developed her first identity as an engineer and a sense of the STEM environment. She admits that she was originally assigned to attend a local high school in Crenshaw, California, but one of her Black female teachers in middle school, whose mother was the principal of STEM magnet high school, convinced and “pushed” her and her mother to apply because of the benefits and the school’s reputation. From there, “the rest is history.”
Sawyer

Sawyer is a smart, charismatic, and a slightly shy senior majoring in computer science. She was born in the U.S. and identifies as a Black women or Black Jamaican woman. Growing up in a two-parent household with whose parents who are still together, has been a positive experience in Sawyer’s life. She acknowledged her privilege and thanks her parents for instilling in her a positive work ethic and encouraging her to learn and try new things and simply “giving her options to be who [she] wants to be.” She admitted that growing up, people acknowledged her Black woman identity and automatically assumed “there’s a story attached to it.” Being Black, Sawyer posited does not mean “there is a negative story attached to me or that I come from a broken or single parent home.” She described how she wishes others, especially those in her major, will see her for her worth, rather than assume she “is just different and or needs help.” Prior to attending Elmwood University, Sawyer had the pleasure of attending an Historically Black College and University (HBCU) which was an “amazing experience where everybody looks like you. Everybody’s the same, has the same mentality as you, [and] is geared toward career-mindedness.” If she could change one thing about her current experience, Sawyer would increase the representation of Black men and women in her field so that she can “have the same experiences” and privileges as her white peers.

Serena

Serena is a poised and ambitious senior majoring in mechanical engineering. Originally born in Jamaica, Serena pursued a career in medical technology, which began when she moved to the U.S. and enrolled in a local community college. In vivid detail, Serena described the shock and disappointment she had in the lack of Black representation in all STEM fields in America. Serena explained that “in Jamaica, all of us were Black, but then moving to the states, it was shockingly different because I started at a community college and I like, there were no
girls. It was rarely that you saw girls or even Black females in my classes, or you know just walking around in the STEM fields or buildings.” Over time, Serena’s passion for STEM remained but she later decided to pursue a career in mechanical engineering when she transferred to Elmwood University. She recalls how her passion for engineering was the same for medical technology and that was to break the mold and end the disproportionate gap of Black women pursuing and succeeding in ECS fields. Moreover, growing up as a Black girl, she failed to see representations of herself—it is Serena’s mission to break the mold and empower other Black girls and women to pursue these fields “with the confidence that they can achieve anything if they put their minds to it.” Regarding her identity, she confidently explained how she has “always considered [herself] Black before anything because we are overlooked and underserved as Black people versus, as a woman, in general, it’s more open and accepting than being of a different color.” Serena also went on to say that “I like to stick to color before gender when identifying myself” because in White male-dominated environments like ECS, “you get treated accordingly and you need to know that Black experience is different than all the others.”

**Zaria**

Soft-spoken and with a delicate air about her, Zaria is an electrical engineering junior who identities a Black woman born in the U.S. She admitted to being introverted, which makes it difficult to make friends in ECS, however, during the focus group, she felt empowered to be around other Black women she has never seen before. Because she and others recognize that they are typically the only Black student or female in their classrooms, Zaria acknowledged that she naturally keeps to herself. “Usually, I guess just throughout my school life,” Zaria added, “maybe because I am shy, unless I know someone, I kind of just wait around and see if there's any other people that want to [interact with] me.” Regarding her STEM experiences prior to college, Zaria admits that many of the conversation about these fields were nonexistent at home.
She elaborated, “Something that black parents like, I guess, do not do is encourage their kids to pursue these majors” and she felt that lack of engagement and exposure has been one of the reasons she and other Black students struggle in their courses.

**Shared Alienation, Exclusion, and Invisibility: Untapped and Underrepresented**

When exploring the experiences of the Black undergraduate women who participated in this qualitative study, data revealed that there are systemic factors that work against the representation, satisfaction, and success of Black undergraduate women in ECS, the major themes that emerged were Black women’s underrepresentation, feelings of invisibility, an unwelcoming climate and culture, and a shared sense of alienation. The focus of this lived experience—being a Black woman in this field—is important because they face multifaceted challenges and barriers that contribute to their underrepresentation that shape feelings of being untapped in their fields of study and careers in ECS fields.

**“I’m always the only Black person or the only woman”: Black Women’s Underrepresentation in ECS**

Concerning the theme of systemic factors that work against the participation, satisfaction, and success of Black undergraduate women in ECS, the lack of women and Black representation in ECS proved to be the most salient topics among the participants in this study. Historically, Black women have remained one of the most underrepresented groups in ECS. Thus, the ideas related to underrepresentation among participants seemed to center on the collective feeling that “I’m always the only Black person or the only woman” in all classes.

Each of the 11 participants acknowledged the overall lack of women and Black representation in ECS, especially Black women and described how it has negatively shaped their experiences and motivation. All participants discussed the “elephant in the room” that ECS is void of faculty and peers who look like them. Amber revealed that “I haven’t seen any professor
that looks like me or have my same identities, yet everyone else can find just about anyone who’s a match.” When it comes to Black people, Sawyer revealed, that “it sucks, it sucks, it sucks. We are nonexistent to say the least.” This idea of underrepresentation connects with Zaria who indicated she often scans the halls and classrooms in ECS but never expects to see anyone who looks like her. She feels “it’s just normal here, like any other day without Blacks.”

On the topic of Black women, Serena shook her head in disappointment, revealing she’s “never seen a Black woman in the engineering department” and Mary reaffirmed his reality by recounting she has had two female engineering professors, but never once has she ever seen a Black female professor. Bella agreed, adding that Black women’s underrepresentation is not limited to engineering, it also extends to computer science and “if there are Black women students or professors here,” Bella added, then “I’ve never seen them ever since I’ve been here.”

Equally, Keziah described her frustrations surrounding the lack of Black women representation in ECS:

It’s been disappointing to say the least. I haven’t found any Black women in any of my classes—in none of my classes. It wasn’t until I started my junior year that I actually found like I have like maybe one Black male in one of my classes, and that’s been it. So, I’ve never really been in a space where I can like say, “Yeah that’s another Black woman in my class where I can walk up to her and be friends with her.” And, it was kind of hard for me because like . . . I moved her from West Africa [and] it was kind of like a culture shock for me because there’s literally no one who looks like me, all while being confined in a class with people from different backgrounds but mine.

To make matters worse, Keziah added that being from another country and having an accent only exacerbated her feelings of culture shock because “feeling like you’re the only one is hard but it’s even harder when others are not also so nice, like they’d be like, ‘Oh yeah, you have an accent, I don’t understand what you’re saying’ and eventually write her off.” In Serena’s case, she experienced the same shock as Keziah; when she moved from Jamaica to the U.S, she quickly recognized that “engineering is underrepresented by women in general and to make it
even worse, [she’s] a Black woman, and wants to be present where [she’s] not represented.” Here, Serena’s feelings of breaking the mold did not seem to intimidate her, it only made her want to work that much harder to be the best.

“My voice doesn’t matter”: Feeling Untapped and Invisible

Additional meaning in this thematic category uncovered from what participants shared was the idea that underrepresentation extended to Black women’s visibility and physical presence in their major. Not only did participants fail to see their race and gender represented in their major, every participant shared similar experiences of feeling “untapped,” “invisible,” “ignored,” and “overlooked” by the majority of their faculty and peers. These negative feelings extended to Keziah, who revealed, “I feel we’re constantly being overlooked and not listened to and it’s like [faculty and administration] don’t care. It hurts to know that like they don’t care and feel as if we don’t matter.” These feelings of being overlooked and “as if you do not matter” is not a new feeling for Bella. She walked me through a time during her freshman introduction to computer science course, she was assigned to work in a four-person group, including her and three other White males. All groups were tasked with answering a specific programming problem and Bella recounts how everyone was stumped until she stepped up and suggested an answer that I had seen work before and was certain was correct. Shaking her head with frustration, Bella remembered, they purposely “skipped over it and brushed me off saying that’s not correct and they got it wrong in the end anyway. The teacher grading us was like that’s incorrect, she was correct. But did they even acknowledge that—of course not.” While feeling proud, Bella was still angry because this common experience for her, and like all of her peers, she has a right to learn and be engaged. “Whether or not I’m wrong or right,” Bella added, “I’m answering the question, which is the whole point of being in school and learning. It shouldn’t be
that my voice doesn’t matter.” Ultimately, Bella clarified that being overlooked by her non-Black peers, only empowers, validates, and affirms her presence.

Like Bella, Serena experienced the same feelings of invisibility and being overlooked by peers and faculty and feeling like he has to go above and beyond just to be seen or heard. She takes pride in her Black female identity and feels like this is a great advantage, but in the eyes of those around her, Serena feels that her voice is not going to be heard, she will remain untapped and overlooked, and have to scream to make herself be seen or have a voice. Moreover, she added her own perspective as a Black woman:

You have to speak over everyone else because no one really takes you that seriously. It’s all assumed from the get that we aren’t smart, so they ignore us. I know other [male] engineers are like, “She doesn’t know what she’s talking about” so when you say something, they don’t listen to you . . . it’s like whatever you say goes in one ear and comes back out the other side.” So, I feel like sometimes no one listens to my opinion, and when I do have something to say, it’s like I have to work twice as hard to get my opinion out there and it’s always questioned or challenged, versus other [people’s] opinions.

For instance, Serena described times during her senior project, where whenever she or another Black female gave out opinion on something, it would just “get shifted to the side and they’d go, “Yeah, yeah, yeah, yeah...” and act like they acknowledge what we had to say but later ignore you like it never happened. It’s basically like we aren’t important, or opinions aren’t worthy.” Explaining how the ordeal is exhausting and can play tricks with your mind, confidence, and self-worth, Serena explained that you just “have to stick with it and push through it all.” Like Bella, Serena repeats in her head: “Don’t let that stop you—let that be your motivation.”

Makasa shares that same resilience as Serena who found other ways to resist feelings on invisibility where her voice does not matter. Makasa revealed how she is mindful about where she sits in class to resist racialized, gendered structures, including microaggressions, and refuses to conform to systems of oppression in her major. Having learned about the tactic of situating
herself front and center in the classroom from a textbook in her introduction to engineering course, Makasa revealed that “being in eyesight with the professor where he has to make eye contact with you,” it made her feel less invisible, more confident, and a part of the classroom experience. She recalled, however, that although the experience was not easy or successful in every class, it did help in an effort to resist racialized, gendered structures. Makasa felt that placing herself at the front of the classroom allowed her to forget about some of the racial and gender barriers that exist and refuse to conform to the systems of oppression. This strategy worked for her by eliminating the necessary noise and distractions of feeling invisible and alone, Makasa recalled how there were many times where she could kind of forget she was an African American woman in a space that was not originally designed with her racial and gender identities in mind to flourish and succeed.

“**It was a boy’s club**: Unwelcoming and Gendered ECS Culture and Climate

   Extending the theme of systemic factors that work against the Black women’s representation and success in ECS, navigating unwelcoming and gendered ECS culture and climate proved to be prominent among the participants in the study. When asked to describe a time her sense of the unwelcoming ECS culture and climate, Glory revealed:

   OK, let’s say you’re already in the elevator, right? And somebody comes in, then they go to a corner far away from you and they clutch their purse, or they move their backpack, or they hold their phone tighter. And it’s like at first, I never noticed until I noticed once, and then I always noticed after that. And it’s like what? I was already in this elevator. What am I trying to, what? And it’s just so annoying.

   Describing the deafening silence that ensues, Glory explained that they do not acknowledge her, and immediately dart or shift their eyes in all directions but hers. Because she expects the same treatment, she plays music louder or busies herself on her phone to resist the racial and/or microaggressions that happen on a daily basis. When asked what happens when she enters an elevator in the ECS building that is already occupied, she laughed and said, “they scoot all the

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way back which makes me immediately uncomfortable, so now I scoot all the way away 'cause like, why are you scooting away?” Here, Glory describes the daily experiences of being a Black woman in ECS spaces. She also added that these experiences extend to the hallways, bathroom, classroom, and basically “anywhere inside the [ECS] building . . . and it just makes you feel like an alien” and unwelcomed.

In Zaria’s case, she described the culture and climate as cold and dominated by male peers, which makes it hard for her to be extroverted and make friends immediately. Being shy in these majors has made it difficult to learn the material and develop a sense of belonging, but she admits she tries every day and looks forward to joining various clubs on campus, like NSBE and SWE. Zaria continued to describe her sense of belonging as a four on a scale from one to ten, with one being “feeling extremely welcomed and zero sense of belonging” and ten “feeling very welcomed and full sense of belonging.” In general, Zaria added that she “keeps her head down” when walking in ECS building to avoid people looking at her like she “does not belong here because it’s the way the like look at you” and guesses she’s “been doing that just to be very not noticeable.” Here, Zaria explains how she maneuvers through the building quietly, with her head down to resist negative feelings of belonging.

Another example of the unwelcoming and gendered ECS culture and climate can be seen in Cathy’s case. Cathy described how for most of her life until she came to Elmwood University and majored in mechanical engineering, she has felt empowered and encouraged as a woman to aim high and speak out and “has never really experienced being excluded because [she] was female.” “Looking around and seeing no one that looks like me” Cathy explained, “was a huge shock and a little hard for me to handle, especially with having to also adjust to a coed
environment where almost all of my classes are male-dominated—it was a change and intimidating at first.”

Similarly, Amber recalled how almost of their ECS courses were taught and comprised of all males who did not make much of an effort to include them. With no Black students in sight, Amber noted that when she arrived to Elmwood University and began her core computer science courses, she felt so out of place and unwelcomed because the majority of her peers were White males. On the first day, the professor asked who had any prior programming experience in that moment—Amber counted every hand that rose and they all belonged to her White male counterparts, leaving her and a few other Students of Color exposed and without their hands raised. When asked what made the experience so unwelcoming, Amber explained that males in her class “hardly ever spoke to [her] unless they had to and never made effort to invite me into you know their groups—it was a boy’s club. So, I just continued to feel very excluded, like I wasn’t supposed to be there.” The notion of an unwelcoming gendered ECS environment extends to Glory, who painfully described negative experiences while attending tutoring in ECS. Glory recalled how it felt like a waste of time and that they approach Black students, especially Black women with a deficit mindset. “They approach you,” Glory added, with this “automatic approach like you don’t know anything and that I’m going to be a waste of time.” She also recalled how it is always a game of back-and-forth having to “confirm and prove” her knowledge when she ends leaving more confused than when she came time. Ultimately, Glory felt their treatment is unwelcoming to Black students and if she were to react or approach them in a manner that undermined them, “then I’m gonna be the mad girl. The mad Black girl.”

Moreover, all participants expressed notions of a gender hierarchy where their male peers benefitted from the privilege of being a male.
From a different perspective, Makasa agreed with the unwelcoming and gendered ECS climate and culture but also identified being a part of the MESH program provided her the opportunity to be surrounded by and engaged with friendlier and more approachable male peers where levels of male privilege and misogyny appeared to be less present or exercised because “everyone in the program is so focused and happy to be a part of it…I think, even though there were a lot of guys, the treatment [from them] was not the same” as the negative treatment she encountered from the males in her classroom and outside of the MESH program. “It was a different respect” she described, that the male peers in the MESH program had for her and other students of color.

Black Women’s Privileges Not Their Own: Misogyny and Male Privilege

Within the subtheme of an unwelcoming gendered ECS culture and climate, notions of misogyny and male privilege were ubiquitous and pertinent to the study. Closely related to sexism, the Encyclopedia Britannica (2020) succinctly defines misogyny as the hated of women. This form of hatred against women can manifest in innumerable ways, including but not limited to sexism, patriarchy, social exclusion, and even male privilege. As part of a system of oppression where misogyny and sexism reproduce inequities for women, male privilege is essentially the notion that men—or others who identify or are identified as male—are granted special rights, freedoms, and considerations, not typically extended to women.

In this study, male privilege seemed to also extend past racial and cultural lines. In other words, some participants felt that no matter the race or culture of their male peer, their male privilege positioned them “higher and more important on the list of how faculty treat you and take you seriously.” Glory agreed that male privilege seems to extend past racial and cultural lines as well. She felt that Men of Color enjoy this same privilege—including Black men—“as a Black woman, [her privileges] are connected to the Black men in this college,” meaning that she
relies on her Black male peers’ male privilege to access resources and/or enter spaces she and other Black women and other women do not typically have access to. Moreover, due to the gendered nature of ECS, Black men inherit their male privilege “to say and do things [she] and other Black girls can’t do” and that can sometimes be detrimental or in the expense of Black women. Glory adds that she feels the few Black males in the college are privileged “just for being males” and can freely enter the “boys club” that exists in ECS. Specifically regarding her Black male peers, Glory felt like there were times when she felt disappointed by their lack of awareness or acknowledgment that they have privileges that other Black women do not and that there are times when they feed into some of the negative stereotypes or treatment that places Black women on the outside. Glory continued:

How Black men in this college treat their fellow Black women, it’s strange at times. I’m friends with a lot of the Black males in this college. They’re really cool but sometimes they have this, they live in this male-driven community and how it treats the Black women and they also side with that. And they don’t realize it sometimes. So, there are situations where it’s like, these negative stereotypes, they’re feeding into it.

“You’re just some creature from another planet”: A Shared Sense of Alienation and Exclusion

A shared sense of alienation and exclusion by their faculty and peers emerged as a significant subtheme regarding Black women’s overall feelings of belonging in their ECS programs. All participants recalled how the lack of Black representation, unwelcoming gendered environments, and racial and gender microaggressions all served as contributing factors to their negative sense of belonging and alienation in their respective ECS programs. Extending this theme of alienation and exclusion, Glory emphasized that Black women are equivalent to aliens in ECS. “Everyone stares at you,” Glory continued, as if you don’t belong and “it’s like you’re an alien sometimes. Like it really feels as if you’re just some creature from another planet that they just don’t understand.” She also explained that Black women, regardless of faculty, staff, or
anyone passing by, people simply just stare at you like you don’t belong, or they want to know all about you. Glory added:

Black girls’ hair is versatile. We change our hair a lot. I’ll have braids one week and the next I might not. But it’s everyday walking into class and the entire class side eyes you and stares at you. “Is that your hair? How did it get so long, why does it look like that?” I swear, it’s like you’re an alien and just get questioned on who you are. Like if it was the girl next to me, the Latina girl, you’re not questioning her hair that’s always changing. . . or if I wear a scarf, they’re like, why are you wearing a scarf? Because I want to wear a scarf. Why does it matter to you? It’s like anything you, any move you make, you’re watched and it’s such a big deal to people. It’s exhausting and makes you not want to come to be here.

Adding to this story, Glory recalled a time while sitting in her math class, lost in thought, one of her of Asian female classmates was staring at her and reached out and pulled my hair. She sat there in shock looking around and no one else even acknowledged or said a thing. She added:

No one else pays attention and I’m the only Black person in this class so of course no one else sees it, but I’m just wondering the whole time, “What are you doing? Why are your hands in my hair, pulling at it?” It doesn’t matter what race I am; I am not going to put my hands in your hair, that’s your personal space.

In more words, Glory explained that is a history and sensitivity surrounding Black women’s hair—it’s sacred. Extending the topic of feeling like an alien and on display, Camille described how, as a Black woman in her undergraduate at a similar state university, she enjoyed having longer nails and embracing her female identity, however, it was not conducive with the culture of the college. Ultimately, when asked when she does not feel like an alien, Glory added, “honestly, never in this [ECS] building haven I ever not felt like an alien.”

Similar to feeling like an alien, Camille noted how she felt her Black image was scrutinized, judged, and frowned upon and did not fit the non-Black mold that everyone is accustomed to. Camille added, “I had long nails, different hair styles, and different things that I think that, my peers were like, “What is going on here? Why is this girl dressed like that?” Camille continued that she felt hypervisible because other women did not dress that way and
made her feel exposed as a Black woman who did not fit the part. Moreover, she explained how her Black femininity made others uncomfortable and gave off the impression that she did not “belong here.”

The experience of alienation and exclusion is a prominent theme in what participants shared. Bella recalled a time when she felt excluded and alienated by her peers. During her introduction to software engineering, Bella recounted a time when groups were being assigned. At the beginning, no one had even wanted to make eye contact with her. She felt invisible, overlooked, and as if no one wanted to mind her presence and get stuck with her—assuming she was uneducated. It was not until it was encouraged for everyone to go around and introduce their experiences and interests that others began to acknowledge her and recognize that she was knowledgeable and a good addition to the team. “It’s those moments,” Bella adds, that they “don’t even entertain the idea like I may actually know something or that I’m even there unless I show them. I hate it and that didn’t feel great because it was like, you just thought I would be stupid.”

Ultimately, all participants in the study revealed that they and other Black women find themselves underrepresented in a major that was never designed with their race or gender in mind, feeling invisible and left with untapped potential, navigating an unwelcoming gendered ECS culture and climate, and sharing a sense of alienation and exclusion from their peers, faculty, and within their respective majors and ECS overall. While these experiences are exclusionary and traumatic, I next report on participants’ double bind in ECS, that is the unique sets of challenges Black women encounter face in ECS while also resisting oppressive systems concerning their race and gender and race.
Racial and Gender Discrimination: Systems of Oppression at the Intersection of Race and Gender in ECS

For most Black women in STEM, especially ECS fields, the intersections of race and gender present challenging barriers, as they frequently reported instances of multilayered oppressions and discrimination rooted in their multiple gender and racial identities. These racialized and gendered barriers that Black women encounter in ECS stem from systems of oppression that are not only embedded in the fabric of American society, but also firmly ingrained within institutions of higher education. When exploring patterns related to racism and racial and gender discrimination, the major code clusters revolved around the Black women’s double bind, racial microaggressions, gender microaggressions, and racial stereotypes, including angry Black woman and Black student motherhood.

Intersectionality and ECS: Black women’s “Double Bind”

The subtheme of Black women’s double bind in ECS fields emerged from the theme of racism, gender discrimination and a sense of misogynistic hierarchy. Through intersectionality, we recognize that Black women’s experiences in ECS fields are subject to the complex interaction of racism and sexism, intellectualized as the double bind (Ong et al., 2011) and encounter the unique sets of racialized and gendered structures while navigating their fields that are in conflict with her race and gender identities while situated in ECS that are dominated by White, Middle Eastern, and Asian males. Thus, for participants, the double bind Black women face in ECS included racial and gender microaggressions and racial stereotypes.

“No wonder it’s hard for Black women to succeed”: Racial and Gender Microaggressions

With racial and gender microaggressions, Black women in ECS fields experience subtle yet daily and persistent forms of racism that adversely affect their lives. It is common knowledge among Black Americans that Black women’s image are the most policed, scrutinized,
and judged. These forms of microaggressions can seem more subtle than other types of discrimination, but they can have lasting cumulative effects in the long run. For Black Americans in general and Black women in particular, they are often victimized in their interlocking systems of oppression; these spaces were never truly designed for them to succeed in the first place.

Racial and gender microaggressions are nothing new for Glory, who indicated that the most consistent place she experiences racial microaggressions is when she is tasked to work in groups for group projects. It is where she feels the “most vulnerable” and like she is navigated this “whole experience differently than everyone else simply because I’m a Black girl.”

Recalling a time when she experienced some form or racial and/or gender microaggressions, Glory added:

It’s the first week of school and everyone starts picking their partners and I’m always chosen last. I’m never chosen, I’m not even a thought, right? So, then I have to go around, vulnerable and be like, “Oh, do you want to be my partner?” And they’ll be like, “Oh, I’m kind of already thinking about . . .” and they start making up stuff, and it’s like never mind, it’s fine I’ll figure it out and join the person who joins the class next week last. I’ll figure it out, on my own like I always do. And I know it’s not because I am a woman, it is because I am Black, they assume I don’t know anything or I’ll have an attitude, when all I want to do is have the same fair experiences as everyone else. The other groups have women, but I’m the only Black girl and can’t even be an afterthought? No wonder it’s hard for us Black women to succeed.

Here, racial and gender microaggressions can also heard in Mary’s case when she claimed that it can frustrating dealing with racial microaggressions and non-Black faculty and peers assuming she and her Black peers are not educated enough. “I can’t tell you enough,” Mary explained, how often “I was told ‘I don’t want to work with you,’ like just that clear. So, you learn to deal with it, it’s all part of the Black female experience, sadly, but you move on.”

Another case where a participant felt racial and gender microaggressions were at play was during the development and presenting of Makasa’s senior project at the annual student project competition. Over the course of working on the project, Makasa recalled being the only
Black student and only female lead among other male group leaders. She remembered the lack of investment, care, and guidance from their Latino male faculty mentor. Makasa walked me through a time where the professor rejected questions or ideas about their work and required them to go back several steps, without giving “reasons behind why [they] had to go back to the beginning and do deep research.” She recalled looking around at other groups, primarily those with all-White members and not seeing the request to do extra work that would add unnecessary time. It was no until later that she realized he purposely told them to use the incorrect motor for the robot and assigned them “more work, slowing us down, and I’m looking at the other groups, who are White group leaders, and none of the others were asked to dig deep like us.” After taking a moment to pause, Makasa shook her head in disbelief, almost forgetting it happened.

She continued:

> You know, the forces he threw on us to look for this model and the calculations that he never even asked of the other groups, I just ignored it, told my team, and just did what he asked, gave more calculations, and came back, [only for him to say], “You’re not supposed to add to it.” And I’m like, “What does he really want?”

In the end, Makasa revealed that she and her team ended up winning the senior project competition, even though they had those additional forces he arbitrarily threw at them and the faculty mentor was more invested in the other White male group leaders. Makasa smiled:

> So, we did that and as the end, because he was biased, didn’t think the team [with the Black female lead] would do it, and the other team couldn’t work as hard as we did. So, with all the extra unnecessary work and focus he threw on us, our robot ended up taking off and did the job it was supposed to do, and the other team it never took off. So, when it was about the end, he realized, hmm nothing was happening with the other group. And then now he would come back to us and like praise us. Like where you from the beginning? Now that your team failed, you want to come back and praise us. I felt like that was segregation, and not like, I don’t know I thought it was racially unfair. He failed us for quite some time until he realized we were actually doing the right thing, then he suddenly switched.
Adding what was even more funny was that he was not even the one judging their work, it was the people from industry who made the final judgements. “So, it was like he was working against us at first,” Makasa concluded, “until he realized we were doing well and making him look good. It was disappointing.” Here we can see the trend in racial and gender microaggressions in Makasa’s case. The subtle lack of investment and additional barriers and work thrown on her and her team created an unfair and inequitable environment tinged with unfair competition.

**Resisting Black Women Stereotypes**

The subtheme of stereotypes revealed that all participants suffered from stereotype threat, that is, the fear of conforming to negative stereotypes that are attached to your multiple identities. Salient to this study, the stereotypes were the “angry Black woman,” the “dumb Black girl,” and “ghetto, single Black mother” stereotypes that participants reported were reproduced and reified in their experiences in ECS.

“**You’re always the angry Black girl**: Black women as Sapphires. As discussed throughout, all participants and felt intimidated, angry, confused, and/or alienated, and oftentimes those feelings manifested into physical reactions and/or negative thought processes. For Black women, these physical manifestations can be detrimental to their academic standing and reputation and label them as Sapphires, a term that portrays Black women as loud, rude, spiteful, or arrogant, and what many refer to as “the angry Black woman” stereotype. As seen in Glory’s case, she explained:

> If I react or respond to a professor in some kind of way that’s assertive or defensive, or questioning them . . . even a classmate, then I’m automatically this or that . . . without care to what just happened to me. But it doesn’t matter because I’m already that stereotype in your head.
Here, the same stereotype threat of resisting the “angry Black Woman” stereotype is seen in Bella’s case. She recounted how if she is in a situation in class and needs to bring something up or has the correct answer and wants to share, she must take a moment to control how she speaks and be mindful of how others perceive her so that she does not come across as angry or assertive. She adds:

If it needs to be brought up and like you’re trying to like tiptoe or like you have to be like super extra nice so that it doesn’t at all come off as aggressive even though like it wouldn’t have come off as aggressive if someone said the exact same thing but for some reason like if I say it, it’s like scary.

“I don’t want to be the dumb Black girl”: Dumb Black women stereotype. Resisting the “dumb Black girl” stereotype or feeling like the unintelligent Black girl was another stereotype that Black women encounter within their majors that works against their confidence and sense of belonging. Here, in Zaria’s case, she explained how every day in the classroom has always been an awkward, weekly challenge because students naturally have questions that need to be answered. Unlike many privileged non-Black students who can ask questions freely, multiple times, incorrectly, and without any bias, Zaria shies away from asking questions or trying to solve a problem in groups during open class discussions. She explained:

I guess just in general, asking questions in class is uncomfortable, just thinking that my question and how it may be a dumb question. I don’t want to be the dumb Black girl. Even though professors, sometimes they say there’s no dumb questions, you can absolutely tell when someone asks a similar question, how they react to it.

Essentially, any time she has raised her hand or approached a professor with a question, Zaria could see in their nonverbal cues “that they think your questions are and that I really don’t belong here.”

Zaria’s feelings are consistent with Amber who also explained that she is either diverted away or encouraged by faculty first to seek help from other peers first if I have questions. She
has always wanted to reach out to others, but, as she explains, “I just instantly feel intimidated because I’m always the only Black girl and feel like maybe I'll be the dumbest one in the group or something.” Extending out of the classroom and into academic advising and counseling spaces, Amber also shared parallels stories about feeling like the “dumb Black girl.” Amber recounted many times during early advisement and counseling sessions:

I found myself working with counselors who were white and they, they would more so try to dumb everything down, dumbing it down in a way like when it comes to your schedules and maybe you shouldn’t take this, or maybe you should wait. Even when I told them I know my capabilities. I’m not the dumb Black girl you think I am. I know my strengths and my weaknesses, and I know what I can and cannot do.”

As a result, Amber used avoided these spaces because she knew their mentality would see her as a deficit and ultimately her time to graduation.

“Where’s your baby daddy?”: Single Black mother stereotype. Single Black mothers often fight the stereotype that they are either lazy or ghetto and in desperate need of a “baby daddy” to help them survive. While also resisting oppressions attached to her race and gender, Mary discussed the multiple intersecting oppressions that attack her race, gender, and class. Regarding Black student motherhood, Mary was the only participant with a child and discussed her negative microaggressions attached to her “poor, ghetto, single Black mother” stereotype. She felt that Black student motherhood is one of the worst stereotypes and elaborated on one instance a year ago:

While working on a group project, I had to leave to pick up my daughter, and my Asian female peer jokingly asked, “Well, where’s your baby daddy? He can’t do this for you?” And I’m just like oh my gosh . . . And it was always my non-Black female peers, never a Black or male peer. And they’d ask if all Black mothers are single . . .

Mary shook her head and explained that not all mothers are single by choice and that these stereotypes and microaggressions made her the most uncomfortable—even more than any racial or gender aggressions.
Faculty and Peer Interactions: Uneven and Inequitable Balance of Support and Faculty Diversity

A central thematic category related to faculty and peer interactions emerged among participants. Here, segmented and coded text seemed to revolve around positive and negative themes—those on student-faculty interactions included negative student-faculty interactions and a lack of faculty diversity (race and gender), and peer interactions included peer support, peer-group dynamics, racial and gender discrimination, friendship, and competition.

Student-faculty Interactions: Positive and Negative Experiences

All participants in this study revealed both positive and negative student-faculty interactions. Salient to this study were the negative student-faculty interactions—both in person or through email—and the evident lack of faculty diversity, specifically Black faculty representation. Together, these experiences paint an understanding of how faculty may serve as barriers to Black women’s academic success and feelings of belonging in ECS and how a lack of diversity in faculty representation both contribute to the underrepresentation, alienation, and lack of belonging in these fields.

“I’m actually trying to learn and none of you guys are trying to help me”: Negative student-faculty interactions. One of the main subthemes that emerged from faculty support and interactions includes negative faculty interactions that hinder their satisfaction, persistence, and academic success. Serena described her negative experiences with professors and how they treat Black students, especially Black women, differently than every other student in the classroom. She feels that ECS faculty share a common lack of interest and investment in their Black students’ education, even more so for Black women, and believes many of those interactions “seem like a complete waste of their time.” If you email a professor, as Serena recalls, faculty responses are so “obvious they don’t care, and some teachers just stick to the
question and don’t bother going off topic or elaborate on something that they know deep down will help you to better understand the material—it’s like they just don’t care.” This idea extended to office hours. Here, Serena explained that the open invitation did not seem to apply to Black women or Black students in general and that her White and non-Black peers “naturally” received more guidance, support and access to information and materials than Black students.

When asked to walk me through a time when she did seek help during office hours, Serena described it “like walking through a maze” just to get simple help. She elaborated:

You have to strictly go through the books, like email first, but good luck with a response. If they reply, you can just tell the tone of their email, it’s straight to the point, like you know I don’t really care let me just reply because I have to. Then, there’s other stops while other people can just pop up and overstay their time while you’re sitting outside waiting—and they know it. And then, the teacher doesn’t even have the manner to come out to tell you to give me like five minutes, he sends the student who then has to come out and tell me to give him like ten minutes or whatever. So yeah, I just feel like teachers, they don’t really care about Black individuals and our White counterparts are encouraged more because . . . and it’s messed with my head countless times making me feel like Blacks aren’t going to succeed and why waste my when I can be somewhere else where I feel more welcome and treated like the standard.

Lastly, Serena described how she can count on two hands how many times she overhead non-Black faculty members telling Black students that ECS majors are not for them and that they should consider other non-STEM majors if they want to be successful. These negative faculty interactions have deterred Serena away from relying on faculty when it matters most. In the end, she has missed out on countless opportunities that are readily available to others.

Participants shared other negative interactions with faculty. In Zaria’s case, she shared that she has observed ECS faculty tease Students of Color and other female students on a consistent basis. “You almost expect it,” Zaria admitted, that most ECS faculty she has come across find some sort of joy in making students “feel dumb when you do not have answers to questions they haven’t even gone over in class.” She continued that “a lot of students, including
me, move on to the next class with gaps in what we’re supposed to know, so it’s discouraging when like you get teased and stop asking questions all together.” This notion of teasing extends from Zaria to Amber who admitted she is the perfect example of a student who has been teased by professors after asking a simple question. Recalling a time in her computer science data structures course, Amber approached her male professor to inform him she was having trouble downloading Java, a computer programming language that allows programmers to use English-based commands to write computer instructions. Seeking help like any other student, Amber recalled how, for what seemed like a minute, he stared at her with a blank, disgusted face and berated her for not knowing a simple task. She confided in detail:

I was so embarrassed, I just felt like everyone was staring at me, judging me like I’m the dumb Black girl . . . and in that moment, he really made me feel excluded and like maybe I shouldn’t be in this class or major. The funny thing is, I definitely saw other students ask the same type of questions. Like, “How do I download this thing? How do I start up this thing?” and it was just like a quick, simple answer. But me, asking that same question meant I was dumb, and he just appeared like he didn’t want to spend any time on me.

As a result, Amber resists these forms of negative, unequal treatment and shies away from relying on professors, even those outside of the classroom. She added, while many emphasize the importance of meeting them during office hours for help and guidance, that support seems to be reserved only for the “privileged students who already have experience with programming and don’t have to walk them through a process that we have to do, or something like that. I don’t know. I’m just like really intimidated by them, I guess.”

These same feelings of not wanting to approach faculty with questions because fear of being teased in front of their peers is a common for many Black women in ECS and why this study is important. Black students should not fear their faculty, be required to go through multiple steps to get mediocre support or feel teased or berated by a faculty member. For these
very reasons, Glory admitted that she also stopped seeking faculty to ask questions or gain more clarity on an assignment. Rather, to avoid negative interactions, she finds alternative ways to obtain answers because she does not receive the same welcoming treatment as her non-Black peers. “I don’t ask anymore,” Glory explained, because if I do, then “now I’m that unintelligent Black girl or I’m confused and don’t understand. Whereas we’re all confused. Isn’t that why students ask questions? We’re here to learn.” Moreover, Glory posited there’s racial or gender issues hidden behind these negative interactions because for her it is beyond “just being a student, it’s that because I am a Black girl, I’m not going to understand. It’s like they have no hope.” Releasing a soft sigh, Glory explained that because it can be demoralizing for faculty members to just shut you down and brush you off like you do not matter, and that is why she avoids faculty interaction almost at all costs.

Being shut down and brushed off could be seen in Glory’s detailed account of a time when a faculty member treated her poorly. Glory recalled a time when she approached her professor to inquire about coding and C++, and he brushed her off and told her to work with her partner. She explained that she did not have a partner and that her peers were not being helpful, yet he told Glory that he would not spoon-feed that answer to her and that she needed to learn like everyone else. She gave him the benefit of the doubt, assuming perhaps that was his teaching style. It was not until later that she peered from her desk to make out one of her classmates—an Armenian male—approach the same professor, ask the same question, yet receive a different, “friendlier response,” one that was met without question, hesitation, or brushing him to his other male group members. In that moment, Glory thought to herself:

Why did you just go ahead and give them the steps to it, but not me? I can’t say that because then I’m causing trouble. So, now I have to go to [that student] and see if he is willing to help me and hope the professor doesn’t think I’m trying to cheat off and copy his code. That’s the one thing I hate. Every time I tried to ask for help, they just assume
that you’re trying to like just to copy off my peers and it’s like I’m actually trying to learn and none of you guys are trying to help me.

Here, Glory’s story denotes the powerful faculty barriers working against and can also be understood by Camille’s account of negative interactions with her professors, which are far from novel.

Camille walked me through a time during her undergrad at another similar state university when her structural analysis professor failed to provide her the same accommodations, he offered other non-Black students. She asked if she could take her third exam a few days earlier in order for her to attend an important student conference that she is a member of and is aligned with her academic and career trajectory. Although he initially agreed to allow her to take the exam early, Camille she realized the mistake was not getting the approval in writing—the week of the exam and a few days before she was to attend her conference, she asked the instructor when she could take the exam and he blatantly told her that the exam was not ready and that she would have to take the exam with everyone else, which completely contradicted his promise that Camille had failed to secure in writing. Baffled and at a loss of words, it was in that moment Camille reached a stark realization:

I felt in my gut that he somehow planned this and never had the intention of letting me take it early or let alone make it up. So, I ended up talking to some of my peers in NSBE and one of the girls had previous exams from his class and he uses the same exams in different semesters. Not only was that interesting because he told me the exam wasn’t ready, and he actually wouldn’t document that I had to repeat the class either. He gave me an [incomplete] in the course and he never gave me a grade.

The negative faculty interactions with this White male professor did not stop here as Camille revealed how his destructive and dehumanizing treatment continued into the summer, when he agreed to meet with her in his office to discuss her incomplete.
When she inquired about the grade of incomplete and why he did not allow her to take the exam early even though he promised, Camille paused for a moment and revealed in astonishment that he looked her in the eye, expressionless that “I was worried about the wrong things, that I wasn’t concerned about being an engineer, I was too concerned about being an outlier, like being a Black engineer, instead of just being an engineer.” Shaking her head in disbelief, Camille remembered walking away from that moment shaking, crying, and feeling defeated. She was able to repeat the course with a different instructor the following spring as it was only offered once a year.

“Not one face was Black”: Lack of faculty diversity. The subtheme of faculty diversity emerged as a salient finding amongst the participants. The majority explained that when it comes to faculty, Black students are fully aware and discouraged by the complete absence of Black, female, and other faculty of color that is not already traditionally represented, such as White, Middle Eastern, and Asian American faculty. Based on her experience, Amber indicated that it is imperative ECS hire and incorporate people from all different identities. She explained:

All I’ve seen now are White or Asian male professors or female professors, some from the Middle East as well. Black students and the college would benefit from seeing their cultures and others teach these classes. It was be so great if they put more focus on bringing in Black professors, and Black women professors . . . because just seeing them in that position would give a lot of motivation to people who feel like they don’t belong.

Here, what Amber shared, hiring more Black faculty members relates to Mary who added that during her time in Elmwood she has only had one female professor and the rest were either White or Middle Eastern men “who just did not have the care or understanding for what we go through.” However, Mary did identify one Persian male faculty member who seemed to be the only one who acknowledged her Black women identity and cared about her future. She recalled
how he was one of the first people she met when arrived and he immediately approached her and
offered to be her mentor. He taught her how to manage her emotions and connected his feelings
of stereotype threat of not wanting to conform to stereotypes attached to his Persian identity to
her fears of being seeing as the “angry, ghetto Black single mother.” Mary also detailed how he
welcomed her daughter and allowed them to spend a great deal of him in his lab and office to
catch up on work, seek help, or simply talk about life issues. Mary smiled when she said:

I am thankful for him because no one else was trying to help me understand me or even
attempt to encourage me to continue. When I was not achieving the high passing grades,
he would remind me of the progress I’ve made and that other students don’t have the
same responsibilities as me. Remembering that the student can go home and study for 8
hours, like I have to go home, take care of my child, cook dinner, pay bills, wash dishes
and clothes you know. He just always reminded me that I have more on your plate and
that I have to balance that.

Mary explained how his sense of care, even if not rooted in Black cultural awareness, is why it is
important to hire for faculty of color to share a sense of struggle that Black students can relate to.

Participants continued to talk about Black faculty representation. For Zaria, she added
that “it would be so encouraging to see more Black faculty and women because it’s not going on,
I'd say that that does bother me.” When asked about how seeing more Black faculty and faculty
of color would affect her academically, Zaria mentioned that she feels it would improve her
sense of belonging and motivation because it is “easy to feel like you’re either not getting
anywhere, or just very stuck, or you feel behind if you compare yourself to the other students, or
where you think you're supposed to be. I think it would help a lot.” When discussing faculty
diversity and representation, Serena was adamant about colleges providing current and future
faculty with professional development and diversity and cultural competency training the best
way to education and serve Black students. She continued that current faculty ECS faculty are
not trained or culturally aware and do not always have Black women’s interests in mind. She
passionately explained that Elmwood University, and all campuses in America should focus on strategies to increase the representation of Black and Brown faculty of color, especially Black women in ECS because they are passionate about their students and their future as untapped, underrepresented and unstoppable forces in ECS fields. She added that she is disappointed in Elmwood University, and most colleges, because she is confident that “there are qualified Black teachers in [ECS] that they can find to come into these classrooms, we just aren’t hiring them.”

With respect to faculty diversity and Black faculty representation, participants pointed to hiring practices. To this point, Camille argued that faculty diversity is so important, and that Elmwood needs to revamp their hiring practices so that there is a focus on diversity, cultural awareness, and cultural competencies. She added her thoughts on what deans and department chairs can do:

Put an emphasis on looking at candidate’s education publications, what community activities they are a part of, and any advocacy, if so, for underrepresented groups? It should absolutely be a qualification. That should be something that qualifies you for the job. You need to show that you’re an advocate for an underrepresented group. And show me how, and what have you done, and what, how do you feel about that?

Moreover, Camille felt that if administration implemented these practices, perhaps Black women would have a better chance of achieve the ECS goals.

Keziah also questioned the lack of Black women in the college, asking “why don’t we have my people in our own college or Black women in [ECS]? We have so many male counterparts from the Middle East and other Asian countries and I just heard a few more were hired recently?” Cathy recalled a time when she walked through the ECS building and was immediately taken aback by a large poster featuring all full-time faculty in all of the ECS majors—“not one face was Black. I can’t remember how many we have but there was a sea of faces that did not even look close to mine. Where is the Black representation?” As a Black
woman fully involved in NSBE, SWE, and WiSE—to name a few—Cathy added that the lack of even one Black face angered and upset her because she there are qualified Black professionals in ECS and those who have graduated from the college who are all qualified to teach.

**Peer Support and Interactions: Complex Relationships that Shaped a Range of Positive and Negative Experiences**

All 11 participants spoke in-depth about the peer support and interactions they had in while pursuing the ECS degrees. All of the participants mentioned that it was important to have a peer or peer group who shared their identity and also aligned with the same goal of performing well academically and offering support to each other while navigating unwelcoming racial and gendered ECS environments. Patterned results revealed that peer support and interactions served as support for Black undergraduate women’s academic work and provided a positive social network on which they could depend. With respect to the subtheme of peer support and interactions, most participants described the same feelings of underrepresentation, feeling untapped and invisible by their peers, unwelcomed by many of the male and non-Black peers, and alienated and excluded from peer group interactions or non-Black spaces. However, more notable were instances where they experienced positive interactions with their peers. A most prominent find the concept of developing peer support groups within unwelcoming, gendered ECS environments that helped Black undergraduate resist forms of discrimination and oppression associated with their race and gender.

“*We teamed up and joined forces in every group*”: Developing peer support group(s). Given Black women’s underrepresentation in ECS, the unwelcoming gendered ECS culture and climate, shared feelings of invisibility and/or exclusion by their non-Black peers and faculty, most participants discussed how they sought out the few peers they could rely on to persist and survive the challenging ECS curriculum and resist negative experiences and
encounters in their majors. When participants discussed strategies to work effectively with peers, they first recognized how their non-Black male peers engage in the similar, yet unwelcoming arrangements, like the “male huddle,” where men collaborate with each other and exclude women. On many occasions, Makasa described how “the men, the boys, guys, always just team up. They’d always ignore you and I’m just like . . . I need to have a friend where I can be like let’s group up and be together.” Teaming up also helped Mary and Makasa succeed and navigate throughout the entire program. As Makasa explained, we made sure “we teamed up and joined forces in every group—we made sure we were there for one another and that’s how we succeeded and graduated together.”

Along the way, having someone to bounce ideas off of and remind you about upcoming assignments, exams, and more proved to be successful, especially for Makasa who found their connection to be “one of the many reasons we never missed an assignment.” Similarly, Mary felt teaming up with Makasa and other peers to be linked to her academic success. She explained how “I was able to get a group of friends not just Black friends, but a group of friends that I still text every day and we still support each other every day through class.” Her peer support group connections helped her persist and was “kind of like a beast and kind of buffered me from having the bad interactions with other people.” She continued, citing the senior projects, where “the professor, all you need is maybe an extra person to maybe finish senior [project], and that’s literally what he told us. You and her, you together you get an extra person, you’re gonna do good.”

“No one wants to work with the Black girl”: Negative peer-group interactions. In-class peer-group interactions are interactions that exist within the classroom and often create unique sets of racialized and gendered challenges for Black women in unwelcoming ECS spaces.
Most participants indicated feelings of anxiety or frustration when having to work in groups. In Serena’s case, she described a time during her senior project capstone course when she was working in groups and they were assigning roles and tasks to be completed. Serena explained how, like clockwork, she was assigned the small menial tasks the ones that were insignificant and had no overall effect on the grade. She inquired why there was always an issue with uneven divisions of labor where they get to do more challenging work and gain the recognition and put her and other Black students to work on things that were irrelevant. Serena also added that “if I would ever make a mistake, I wasn’t told about it.” Rather, her peers would often laugh and have discussions on the side as if she was not aware.

Another example of a negative peer-group interactions can be seen in Glory’s case, where she indicated her biggest challenges emerged from peer group dynamics and the peer interactions within group projects. “That’s been a hard thing,” Glory explained, especially “coming here from a predominately Black high school where I always fit in and never had issues approaching other people and getting them to want to work with me.” In other words, she felt group dynamics always bring out the negative side of her and she felt she must be in “alert mode” the whole time in order to resist racial or gender microaggressions or simply avoid stereotype threats.

“No luck in tutoring”: Negative peer-tutor interactions. Tutoring is a space where students can seek the academic guidance and support they need to achieve academic success. Many of these tutoring spaces exist and are housed within their respective colleges. Since ECS students take mathematics, physics, chemistry, biology, and subjects in their respective majors, they often find themselves attending and experiencing two or more tutorial spaces that “are almost always not Black-friendly.” Negative interactions with peers and tutors were common
experiences for participants. For Glory, her experiences included negative feelings of belonging, having to continuously confirm/prove herself to others, check herself and her Black women identity, and overcome barriers to learning and obtaining the same education as more privileged counterparts. Speaking to this point, Glory’s frustrations were evident:

You walk into the tutoring lab and all are on immediately on you. They’ll ask, “Are you in the wrong place?” No, I’m not in the wrong place. Can I get my tutoring for this class? Oh yeah, um, this class? Again, with the confirmations. Like why, I just told you this class. Why would you ask me again, this class? Like I just, yes that class. Right? I have to check myself. There’s a lot of like, for unnecessary things that just don’t need to be questioned, like if I just told you this class, why? And then I’ll go to a tutor and now the tutors just like oh, um, this is this class. I’m like oh my God, here we go again. And it’s like ok, yes. I need tutoring for this class. I have this homework assignment. Can you help me with it because I just ignored the question again? I just go straight to it. That’s my tactic now. And it’s a lot of forming tactics to get out of those situations so you don’t react how they want you to react. It’s a lot of that.

Glory’s story continues with Amber’s descriptive account, when she revealed how tutoring has been ineffective and where she would feel hypervisible and out of place while being a Black woman in unwelcoming, gendered tutoring spaces. She recalled a time during her freshman year when she had tried to go to tutoring, sat down and talked to a tutor, but felt exposed and out of place. She explained that it was a “point where I just kind of zoned out, because I just felt like I wasn’t on the same level as everyone else. The people that I was talking to were like White, and everyone around me was White. It was a moment of like, ‘Am I in the right major? Should I be doing this?’ Yeah, and I haven’t been to tutor since then because it was a really weird experience.”

Another tale of the negative peer and tutor interactions ended with Sawyer, who recounted negative feelings of belonging in tutoring spaces at Elmwood. She explained:

Sometimes, I’ll go to tutoring but I don’t really get help with that because they’re not as like, receptive and helpful. But when I find myself in tutoring, I end up tutoring other people and I’m not even getting paid for it. Those interactions were just weird though.
because you give support to your fellow peers and then don’t really get it back—like you’ve been used.

Moreover, Sawyer goes on to explain how the tutors seem to “suddenly not know how to approach a problem” but just saw them spend extra tie with others on similar questions. She adds, “I always end up getting the ones who don’t want to help or the say, “Oh, I don’t know if I can help you or not,” and I’m thinking then why are you here? Lastly, Camille concluded that tutoring spaces in ECS and other STEM spaces at her undergraduate campus are often racially segregated, and that colleges and universities need to be more mindful and purposeful in offering “tutoring for all students, not just a certain group.” What she means by this is tutors and staff being more helpful to more privilege’s students like her White and male counterparts.

**Identity and Culture: Shared Identity and Cultural Barriers Within Systems of Oppression**

Black culture, including Black American and African culture, are ethnically, culturally, and socio-economically diverse. The two subthemes that emerged from a cluster of segmented and coded text about identity and culture are the importance of shared-identity and cultural issues, including an overall lack of Black cultural awareness and cultural barriers between Black Americans and African students that exist within and ultimately stem from systems of oppressions and institutional racism, sexism, and misogyny in ECS fields.

“**It just clicked**”**: The importance of shared identity. Shared identity revealed to have a positive effect on sense of belonging. Almost all participants felt like the ideal situation emerged where Black students see themselves in their peers and the faculty who teach their courses. Participants recognized the important of shared identity because it provides and sense of unspoken acknowledgments of shared history, shared struggle, and shared understandings that bonds them. Moreover, because participants often reported feeling invisible and unwelcome in their majors, they explained that having access to faculty and peers that share the same skin tone,
race, gender, and/or culture is important because it affirms or validates their presence.

Collectively, all participants noted similar/overlapping feelings of belonging, acknowledgement, and empowerment of seeing Black peers and Black faculty who share their identity, noting how it provides them someone to whom they can relate and aspire or emulate.

Discussing the importance of shared identity, Cathy explained how she was privileged to have been taught by Black professors in and outside of her major, and that having an instructor who understood her on a personal or cultural level made a significant difference in her feelings of belonging and motivation to succeed. She explained that she excelled because there was a shared, mutual, and unspoken understanding of her expectations as a Black woman in STEM and she felt comfortable. “No words even had to be spoken,” Cathy explained, because “it just clicked, and I always felt like I belonged and mattered,” which is a feeling that contrasted her non-Black professors who just seemed less interested and disconnected.

Feeling acknowledged, academically challenged, and invested in were the three ways Serena described how shared identity has shaped her experiences in ECS. She walked me through an “unforgettable” moment in time during her second semester after transferring to Elmwood when she realized she was going to be taught by her first Black professor in engineering. With bright, excited eyes, Serena recalled:

When I walked into his classroom, I got [goosebumps] when I saw that he was Black I was like, “Oh my gosh, amazing!” And he was like, Ms. [redacted] I was like, how do you know my name and he smiled and was like, “Why are you late?” and I was like, “Traffic, sir,” and I just was just shocked and laughed in shock and excitement that there was Black professor in my major. It was the last thing I ever expected.

With excitement in her voice, she also added how their interactions made her feel acknowledged, challenged, respected, and cared for, especially when he followed through on offering support
during office hours and after class, something she could not do with other professors. She also noted that his treatment was not preferential and that he made himself available to all students.

Extending the impact of shared identity with faculty, we can see in Zaria’s case that having a Black male professor in her introduction ECS course in her freshmen year made her feel “lucky” and instilled a short-lived sense of belonging at the beginning of her academic journey. “I enjoyed going to his class” Zaria recalled, a faint smile emerging as she continues, because he “made me feel welcome” and acknowledged, which was shared with everyone in the class. Moreover, the sheer “fact that he was Black and . . . the same race” shaped Zaria’s sense of belonging. Zaria pointed to “something [she] couldn’t describe, it just made [her] feel like [she’s] the only Black person in the class” and gave her small hope that she will be successful. Unfortunately, this professor retired soon after her class, and Zaria disappointed that she was not able to take more classes with him or simply connect with him during office hours.

Participants described similar feelings of empowerment and shared-identity at the peer-level. For example, Glory offered a story about how she developed a sense of empowerment when she attended her first NSBE meeting and was amazed to learn the president was an African male who shared her culture. Seeing him for the first time, Glory recalls, was a “shock to my eyes because seeing another African be successful, actually taking charge is huge and empowering, especially in these majors where I’m lucky to see another person with my completion, my gender, or who’s African.”

When speaking about the importance of shared-identity in often White male-dominated ECS environments, Makasa spoke on how empowering it is to be taught by Black faculty and who they serve as templates for someone to emulate. To the point of feeling empowered, Makasa explained why faculty diversity and Black representation is needed in ECS and is
directly linked to the same sense of empowerment and belonging that non-Black students gain daily. “To see someone in front of you,” Makasa could barely put to words, “a professor who looks like you—a Black person—it’s really, really encouraging, empowering and just indescribable . . . it’s beyond.”

Beyond this idea that Makasa aptly shared, she spoke beautifully about how in her language, there is a program that encourages you not to look at one’s face and judge them because what really hurts stays inside and does not reflect one’s face. She connected this idea with shared identity:

Someone who is Black and has that same identity as you will be able you talk to you and be more receptive and ask you what is really going on and how they can help you because to be honest, we all mostly feel like [all ECS faculty and students] don’t care about the small sea of Black students—they just don’t care about us. But, if we are lucky and have someone who is Black, they will absolutely say, “OK tell me what’s really going on, where are you struggling” and take care of you from there.

In other words, shared identity is so important for Black women in ECS spaces because they fail to see other peers or faculty who share their Black and female identities.

Reflecting on these stories, it makes sense why all participants agreed that when they do come in contact with someone who shares some form of their identities, it validates and affirms who they are and provides them a sense of belonging, motivating and empowering them along the way. Participants discussed and agreed that they do not feel entitled to shared identity and that it should be in the very fabric of all educational experiences.

Additionally, they were all in agreement that shared identity is a privilege that Whites, Latinx, and Asian students—to name a few identity groups from their individual and collective experiences—have possessed almost their entire academic lives, and yet they overlook this privilege that lives with them every day. Adding to this idea, Makasa posited that Black faculty provided her and other Black students with the care and attention they needed, which is “nothing
more than what our [non-Black] classmates get.” She adds that White students and others who have seen faculty who look like them automatically gain that privilege and “they know what they are supposed to look like, how to move, you know, how to carry yourself as an engineer. We don’t get that.” Makasa explains what others in literature and I have always explained is that for most, the educational pipeline is rich with leaders, teachers, and administrators who do not look like them, leaving them without someone to emulate or aspire to be like.

Ultimately, all participants agree that shared identity—whether it’s more Black faculty, staff, advisors, counselors, women, and more—is vital to the persistence and sense of belonging for Black women in ECS fields. Many agreed that they just need more access to and visibility of those who represent their unique identities and who can “read deep not just give transactional treatment” because the few who do exist are “recognize when you are stressed and need help and if you say I’m hurting they’ll sit down with you and ask what’s really troubling you—basically the treatment other students get that we don’t.”

“People don’t know how to be around Black people”: Lack of Black cultural awareness. Almost all of the participants discussed how they felt their non-Black faculty and peers lacked an overall sense of Black culture and awareness and the knowledge they did have was either biased or ill-informed. Serena posited that the nature of ECS is unfamiliar with Black individuals and in turn, colleges do not know how to deal with, support, or understand their cultural needs. She added that perhaps STEM, including ECS, is failing Black students because they do not care about their well-being or understand them. She continued:

It’s like general knowledge you should know and care about but they act as if they don’t know and it’s like if you don’t care about situations affecting us as humans then how are you going to care about me as a human and be my friends and understand me and my culture? And a lot of time, people think being Black is cool, so everyone wants to be Black until it’s really time to be Black, and then all of a sudden, they want to be hands off and turn a blind eye.
And here in Glory’s case, she gave the perfect example regarding the concept about her hair and how Black culture and some other non-Black cultures, it is “common knowledge that [Black women’s] hair is sacred, personal, and definitely not anyone’s property to touch without permission.” Taking this same concept, Glory posited that most people “don’t know how to be around Black people or how to help them because they’re busy doing everything else but learn about our needs . . . While you cannot change the people, you can make them aware of our culture.” Stripping this issue to the core, it is apparent that the issue stems from systems of oppression and institutional racism that preserve and maintain a lack of diversity in these predominately White male ECS spaces.

“The way we learn, it’s not the same as the way European people learn”: Cultural barriers as learning differences between Black American and African students. The subtheme of cultural barriers emerged between Blacks and their non-Black faculty and peers and Black American and African immigrants. While the experiences are unique and present varying impacts on their academic success, the cultural barriers for all participants present issues for Black women. The cultural barriers and differences between Black American and Africans have been known to be the cause misunderstandings and potential hostility between them. This issue was slightly evident in a few cases where some Black American students felt their African peers lacked the cultural knowledge of Black American history, which prevented some African students from understanding the reality of their double bind in ECS. On the topic of cultural barriers between Black Americans and African students, Mary and Sawyer were the only participants to highlight the notion that African students may possess a cultural privilege that is rooted in their African culture, which then contributes to this idea of “Black excellence” that often prides, promotes, and is held by many as the standard for high-achieving success in the
Black community. Moreover, they felt this form of privilege ignores the plight of Black Americans and feel double invalidated, first within the overall systems of oppression and then within their own cultural, racial, and gender groups. For instance, respective to Mary, she felt African students possess a sense of academic excellence or academic mindset inherited from their cultural wealth and differs from their Black American counterparts.

During a separate discussion on the need for safe spaces for African students, Glory exacerbated the notion of cultural barriers when she said, “For African people, the way we learn, it’s not the same as the way that European (or Black American) people learn.” Thus, it affirms Mary and Sawyer’s arguments that there is a cultural barrier between Black Americans and African students and what Black excellence does not extend to all. Moreover, she added that everyone recognizes, prides, and promotes Black excellence but many do not realize it may be a privilege within itself.” In other words, Mary explained:

People who come from the hood who do this and do that may not have had the same opportunities that those privileged Black or African students have. I feel it is often elitist because like I came from the hood—South Central—and I understand both sides of it and some people don’t see [the cultural barriers]. I see a lot of that in NSBE, that a lot of people are a little bit privileged. They don’t see the opportunities they’ve been given that other people didn’t get and at the end of the day, it makes me feel even more like my experiences as a Black woman are different from my African peers.

You can see here that Mary feels African students may be privileged in the sense that they are not bound by the plight of Black America and are not always victims of the same oppressions or biases. For instance, she walked me through a time where this form of cultural barriers between Black American and Americans was prevalent. It was during a NSBE meeting, and the top shifted to Black Americans and Africans and the topic quickly went south. Mary recounted how they were discussing the clash between Africans and Americans and “what African Americans are doing wrong and what Africans are doing right,” and “how Americans are lazy.” Offended,
Mary stepped in and has to inform them that “as recent immigrants, they sometimes don’t see this Black American history that I think a lot of Black people in America hold onto and it’s painful for them and it’s kind of stops them from succeeding.”

As African immigrants, moreover, that history goes unnoticed and may not have the same grip on them, granting them the freedom to move freely and let a history they may not understand or resonate with hold them back. She further adds that when you have a different mindset of “I just want to make it or want to succeed and be successful” you drive is completely different because Black Americans face the same challenges but often get hidden behind high-achieving Black students who are the select few who gain access to resources, gain the respect of our faculty and classmates, and “get to be the face of Black people” in [ECS] when negotiating feelings of being double invalidated and as if issues will matter or be addressed. Mary continued to explain the differences between Black Americans and Africans. She added that it’s like being in a “different group to friends who are like, my Africans friend who are like, “We’re going to study together t for getting these qualifications” but my other Black friends are like, “Oh, you’re doing that?” It’s like their mindsets are completely different.”

Sharing these same sentiments that cultural barriers exist between Black Americans and Africans, Sawyer indicated that she also recognized and acknowledged the miscommunication or lack of awareness between the two groups. She added:

African students seemed geared toward it. Back at home they’re taught that this—it’s just like second nature and I feel they do not recognize that it may not come as easy for us in the beginning or that we may not have the same push and drive as you because we are too busy trying to deal with being Black in America [or Black in ECS].

Sawyer continued to add that Black American’s are not tapped or pushed to pursue STEM fields and that often contributed to the cultural differences between Black Americans and African students and the misconception Black excellence applies to all.
Ultimately, Sawyer admits that, to this point, “I’ve come across where Black engineers who graduated with 3.96 GPA and I have to look at their last name and I’m like their last name isn’t Williams, their last name isn’t Johnson, their last name isn’t Carter. It’s an African name.” In her words, Sawyer feels “there’s a difference between Blacks and African’s in STEM because sometimes the Africans understand it, but the Blacks just don’t, and I know it’s because their African culture has a strong [emphasis] on academics” versus Black Americans who have a completely different history. Ultimately, Sawyer feels that, culturally, Africans have that African cultural wealth they can rely on to succeed because it is deeply rooted in their nature.

**Developing Academic Resilience and Perseverance to Resist Systems of Oppression: Black Women as Unstoppable**

Important to this study was the notion that Black undergraduate women pursuing ECS majors had to develop academic resilience and perseverance in order to resist the systemic oppression and institutional racism, sexism, and misogyny in their ECS majors. Academic resilience is the ability for individuals to persist, advance, and/or thrive despite experiences that require overcoming barriers, hardships, or adversity along the way. In exploring how participants framed their experiences related to academic resilience, several thematic patterns emerged, including perseverance, self-reliance, and mental health and wellness, maintain contact with advisors and counselors.

“**Believe in yourself, cause no one else will**: Black women’s perseverance.

Developing perseverance qualities in the face of underrepresentation, racial and gender discrimination, was an important finding linked to academic resilience. Perseverance can be thought of as a persistent effort to do or achieve a goal despite barriers, difficulties, and/or opposition. During the focus group, Serena posited that their perseverance is consistent with other Black women in ECS and that because the college is not designed nor equipped to support
Black women the way they need to be fairly and equitably supported, she has had to be self-reliant and always remember to “believe in yourself, because no one else will.” Serena’s words were powerful and resonated with the other four women in the room—inspired eyes all locked on her.

“You have to create your own security within yourself”: Black women’s self-reliance. Given Black women’s underrepresentation, lack of belonging, and racial and gender microaggressions, many participants indicated that they had to be self-reliant in order to succeed because most faculty, staff, and admiration “do not care or invest in Black student’s academics” and that in order to survive, they must develop self-reliance to persist. For Mary, one of the other main perseverance qualifies is developing self-reliance while also being a Black mother in ECS. She claims that “a lot of people are not single moms by choice, there’s different reasons” and that it’s a struggle every day but that does not make her any less capable of being the best student there is and that they should to be deemed as barriers.” Moreover, her self-reliance stems from developing a form of confidence in herself. She recommended to all current and future Black women engineers to “be confident because people will hit on your confidence all the time—so be confident within yourself. You have to create your own security within yourself.” Lastly, she took pride in her humbleness and felt like her value does not “come from being the best, it comes from persistence and determination regardless of the things thrown your way to throw you off your focus.”

With Cathy, additional expressions of perseverance included prior academic struggles, her parents’ resilience, and her involvement in student clubs and organizations as her forms of perseverance that push her through to achieve academic success and be the role model she aspires to be. Based on her experience, Cathy posits that face academic probation and “just
falling behind, being disqualified, and then coming back and sort of rising to the top,” has completed shaped her experiences. Moreover, her perseverance and self-reliance were taught and modeled after her parents’ own personal and academic struggles. Stumbling through her words, Cathy explained how seeing her parents overcome adversity—especially her mom who overcame racism—instilled this mentality of “I can do this as well.” Cathy added that her mother made it this far from living in an orphanage in Korea to performing the top of her game as a nurse in a world-renowned hospital. Through her mother’s perseverance and triumph, Glory described how her parents instilled in her a sense that there is no invisible ceiling and that she can accomplish anything she puts her mind to.

Here, in Serena’s case, the notion of self-reliance stems from being independent. She described how you have to be independent and not based your choices on what society expects, because if we did that, we wouldn’t be standing here today. She added her motto “that if I want to be an engineer, I will be an engineer. You just have to believe in yourself when no one else does. Regarding transitions to the STEM workforce, Black women are still required to be self-reliant. Serena confirmed this:

I won’t say that won’t change once you leave school because it’s like ten times worse because not even being Black, just being a female in general is hard and you have to rely on yourself almost one hundred percent of the time.

She also explained how she has to “work long hours while in school to help support her through college. Plus, long commutes made it difficult for me to be in those spaces that everyone else was in and commuting made it way more difficult for me.”

When asked about her self-reliance, Bella explained how she is “like an independent worker sometimes specifically at school so it’s very rare that like I need to help or someone needs to—well teachers can help me but it’s not it’s never, it doesn’t come up as often, so I’m
kind of to myself a little bit and that’s how I survive.” Bella continued to explain how relying on herself and less on others have helped her get this far. While she does not wish she was alone in the major and wished she had “more people she could turn to in her major,” especially “anyone Black or even a Black female,” she knows the major is dominated by men and that women typically survive these majors alone and accepts that she has to be self-reliant in order to succeed. Here, you can see how these systems of oppression and institutional racism, sexism, misogyny, and more, exacerbate Black women’s their challenges, in turn driving them to develop resiliency and perseverance in order to survive, succeed, and resist additional oppressions.

“I know I’ll be OK”: Mental health and wellness. Regarding the subtheme of perseverance, Bella also noted that her ability to persevere and continue relied heavily on her continued efforts of seeking mental health and wellness services on campus. She identified the one campus professional support staff whom she felt she could go to manage her increasing levels of anxiety and stress linked to the challenging ECS curriculum and her alienation, exclusion, and invisibility in ECS. Bella identified her Black female therapists as some of her sources of motivation. Like Black women in ECS, Black female therapists are almost non-existent at this campus. Explaining how she attempts to resist oppressive systems attached to her race and gender, Bella sought help on mental health and wellness services on campus. She added that she has been personally working in terms of her mental health, which has always been something she’s been passionate about. She explained the importance of attending these appointments:

She’s a Black woman and the only Black woman therapist on this campus. She’s probably, like the only person I could think of as like just someone who is like a Black woman and physically there for the student . . . in my major I’m like all alone and it affects me and to [resist] all of the negative things, I know I can go to her to get help and I know I’ll be OK.
Here, Bella describes the importance of having access to a Black woman therapist to resist and escape the systems of oppression and institutional racism, sexism, and misogyny that exist in ECS and have exacerbated her negative perceptions of belonging. The fact that she was the only Black professional staff in that area made Bella feel special. Without her, Bella recalled, “I don’t think there are many others I feel like I can like go to seek mental help.”

“You have to seek advisors on your own”: Academic advisors and mentors as support. Participants recalled their mentors and academic advisors as sources of support and as a resource that you must have to be self-reliant. Additionally, participants emphasized the importance of utilizing the expertise of mentors as a resource to help them develop a sense of belonging as they persist when times are challenging. With Mary, having a faculty mentor interact closely with her and show her the type of care he did for her academic success and well-being contributed to her persistence and success. She added:

Having a faculty mentor who knows my experiences, they know what I had on my plate, and yeah, he was paid for it but still having them an being able to call them and being able to email them, you know, spending time with a person who can guide you. I wish every student, especially every Black student had a faculty mentor like mine because we would be the ones the students would look up to. So, having that connection is huge.

Here, academic advisors also served as a source of support for Amber, yet she had to seek the right one. In her case, she explained how her consistent check-ins with her academic advisors functioned as a main source of motivation and support. She had two academic advisors, a Black male and Latina female, and she felt that she knew she could rely on them during crucial periods in the semester, whether to talk about her academic performance, lack of belonging, and/or personal issues. Even more so, her advisors helped her “get out of [her] head and remember that [she] is resilient, worth it, and belongs in this major.”
Student Involvement and Engagement to Develop Sense of Belonging in Racialized and Gendered Environments

A final thematic category to emerge from data analysis seemed to center on student involvement and engagement and its impact on sense of belonging. For this study, student involvement is described as any academic or social engagement in which Black women participants sought out on campus to resist structural racism and multiple oppressions linked to race and gender. While most of the study has examined Black women’s double bind in their ECS programs, highlighting their untapped potential, underrepresentation, and unstoppable resiliency, while being simultaneously undermined by racial and gender oppressions, it is important to note that participants in this study were able to seek spaces within and outside of ECS to find a sense of belonging and develop a sense of normalcy.

“You take what you get to feel normal”: Student clubs and organizations. Student clubs and organizations are a common type of academic student engagement and involvement that exists on a college campus and is where networking and social groups are formed. Many of the participants in the study revealed they turned to various clubs and organizations to develop a sense of belonging, resist racism or gendered oppressions that make them feel underrepresented, alienated and unwelcomed in ECS. For Cathy, when she first arrived at Elmwood University, she immediately joined NSBE and SWE “and had this immediate access to the network of both Black people and both females in this very much male-dominated field. I was just so used to walking into a classroom and it was like white males, 95 percent of the class.” Doing so provided Cathy the opportunity to be around diverse student populations, while also “feeling comfortable being a Black woman who is actively engaged in this major.” Cathy also pointed out that she appreciated being around other Black students, but what stood out more was having access to the advisor for NSBE who is one of the few Black instructors in ECS. She explained
that his presence, focus, and care for her and their other students was more than any she has seen in ECS and was fantastic in keeping her grounded, encouraged, and able to fight off feelings of imposter syndrome. Thus, the notion of feeling normal and not alienated or excluded was crucial when it came to student clubs and organizations. In Serena’s case, her philosophy was, “You take what you can get to feel normal,” and for many participants, this statement meant diverting to and involving themselves in Africana Studies, student clubs and organizations, including ASO, NSBE, and SWE, and living in student housing.

Taking what you can get to feel normal also resonated with Makasa and Mary, who both added they felt privileged enough to be a part of a grant-funded program, the MESH (pseudonym) program at Elmwood that is dedicated to increasing the recruitment, retention, and graduation of first-generation, low-income, Students of Color in ECS fields. This grant-funded program was available only to first-time freshmen or first-time transfer students on an invitation-only basis, and is where they and many students in the program experienced positive feelings of belonging and academic guidance and support in the form of faculty mentors, peer mentoring, peer tutoring, and participation in student-faculty research. Mary explained how she found her faculty mentor through MESH and his support throughout her journey is one of the main sources of support and where she felt like she belonged the most. She and Makasa added that during MESH meetings and events, they never felt unwelcomed, oppressed, or a lack of belonging because of the sheer amount of support provided by the program to nearly 200 students. In other words, there was no exclusive, insular “boy’s club” and there was an abundance of mutual respect for each other. She added:

I think because these men were different, they were not like the men out there who treated Black women poorly. And there was no like, “Oh you are African American, or you are a woman or something.” There was nothing like that. We had a common goal, something of that nature. So, there I felt a very sense of belonging even when we have
MESH functions. It was very exciting. The people around there when they see you it's like you want to be where everybody knows your name and appreciates you.

“It’s honestly those classes where I can go to be fine”: Minoring in Africana Studies.

A subtheme of student involvement and engagement and its impact on participants’ sense of belonging was pairing their ECS journey with a minor in Africana Studies. In higher education, Africana Studies can be defined as “the critical analysis of the Africana experience, people and culture, through the usage of the Afrikan worldview, with the ultimate goal of changing the life chances of Afrikan descend[ed] peoples” (Carroll, 2008, p. 6). Thus, a minor in Africana Studies provides students with the basic fundamentals of the ignored histories, cultures, and conditions of the African Diaspora, including curriculum on African history, education, economics, psychology, sociology, theater arts, urban studies, and more. Of all the 11 participants, Glory was the only one who minored in Africana Studies. When asked how Africana Studies shaped her academic and social experiences, Glory lit up, explaining how they helped her to not only develop a sense of belonging but also helped her deal with her feelings of “being the only Black girl.” When it comes to her Africana Studies courses, Glory added:

It’s honestly those classes where I can go to be fine. I usually, I arranged them in a way that I have my engineering classes, then an Africana class, then an engineering class, and then another Africana class, so I don’t get too caught up in the stress of being the [token] or the only display of a Black girl in the class. So, like whenever I’m in my minor classes, I walk into class, and they pay attention to what they’re doing. They don’t stop and stare as you walk to your seat like when I walk into my engineering classes. They literally stop and watch you walk to your seat, sit down, keep looking at you, and then turn around. Like is there, why am I such an alien that you must follow me?

Here, Glory communicated how being the only Black person or Black woman has led her to minor in Africana Studies to mitigate negative feelings attached to her race and gender.

Furthermore, she added that she understands that the field of engineering and computer science is particularly focused and does not leave much room for creativity, and that is why she chose to
minor in Africana studies so that she “can also have that community sense, that sense of pride and solidarity for [she is] and connect it back to what [she’s] learning here and have like a way to understand it on a different level.”

In additional to minoring in African Studies to help resist negative feelings of belonging, Glory added that she is impressed with Elmwood University’s Africana Studies Department because of their proactive approach to revamping their curriculum to be more culturally responsive. For stance, Glory happily explained how the department is discussing ways to develop and implement new curriculum and courses in Africana Studies, like mathematics, that link their Black and African identities into the curriculum to better understand the material and learn their contributions to the field. Glory added, “Creating a class that helps students understand what they can do with their degree in their own community is important because I feel like right now we’re just getting degrees and don’t know what to do with it after . . . if they actually had a reason, felt connected, they’ll feel like, “Oh, I’m [going to] make a difference with this, cause that’s what we are. We are the future innovators, but if we don’t have anything possessing us to innovate and help the future generation, what’s the connection, right? So maybe a class that’s just talk about, if it’s not for specifically Black people, just talk about how to impact communities.”

“I always felt like really at home in housing more than on campus”: Student housing. In terms of student engagement and involvement in student housing, participants seemed to say that living on campus helps Black women develop a strong sense of belonging. Whenever she felt the pressures and/or stresses of an unwelcoming ECS climate and culture or being the only Black woman in many of her STEM courses, she always knew she could resort back to for sanity. Like Glory, notions of feeling “at home” extended to Amber when it came to
student housing on campus. Through a pensive smile, Amber explained, “I always felt like really at home in housing more than on campus. Just knowing I could go back to housing and have people who I can connect [with] and talk to about my day meant the world because there was [no connection] or anyone I can really talk to in my major or like my classes.” When asked about what makes student housing ideal and how it facilitates positive feelings of belonging, Amber added that having student housing hosts Black Girl Magic (BGM) has been “monumental” for her in that it is a place in student housing she “can rely on” and be a part of a community that aims to build stronger connections and between Black students and allied students on campus. Since BGM focused on important issues and topics affecting the Black community, Amber was able to build a community and sense of belonging through student housing to make up for the lack of community and sense of belonging she had encountered in the deeply racialized and gendered ECS environments.

Additionally, student involvement and engagement in student housing was also place where Amber developed her motivation and source of support from role models. She described a time when she was a resident advisor in the dorms, her supervisor was a Black woman who still is very much an inspiration to her. She mentioned that her supervisor was “always just so on top of it, and she's just unapologetically her, and she doesn't have to pretend to be anything else. She never really brought it up, but it was always that feeling of belonging, and checking in and making sure that I was OK.” Her supervisor was also very supportive of her academic and social engagements. Amber recalled how “she would make sure that I was staying on track and not feel as if I couldn't do what I set my head out to do. Amber also felt described student hosing as a place to meet a diverse group of peers who often share the same the same identities. She mentioned that when she had volunteered to be a park council director in student housing, there
was an executive board member who was Black and gave her a sense of belonging and “it was super easy to interact with other people unlike my major, because I see more faces that look like me. It’s a very diverse place” and essentially, it was impossible not to feel welcome.

“I could just be free without having to think about how I’m going to survive”: Safe spaces needed to resist oppressive systems. A subtheme that emerged from feeling alienated and excluded within ECS, and that relates directly to a sense of belonging for participants, was the importance and need for safe spaces for Black women who resist systems of oppression linked to their race or gender and offer them a physical environment where they do not feel underrepresented, invisible, unwelcomed, and/or excluded. One tactic colleges and universities have implemented are the use of safe spaces to address the frequency of discriminatory incidents, like racism, sexism, homophobia, and xenophobia, occurring to students who often feel “othered.” These safe spaces provide students with the freedom to relax, socialize, seek help and support, and/or have open and constructive dialogue on topics that matter to them, without the fear of feeling uncomfortable, unsafe, or unwelcome in account of their multiple identities.

In terms of safe spaces at Elmwood, Amber and Glory were the only two who detailed how safe spaces are important for Black women who constantly must resist forms of oppressions that undermine their success. Glory recalled how her Africana studies courses served as safe space for her as she felt safe and stress-free because she did not have to hide from or display her Black woman identity. Glory recalled, “I could just be free without having to think about how I’m going to survive or get through the day around [ECS] students who don’t look like me or really care about my academic success.” Additionally, Glory identified both the African Student Organization (ASO) and the National Society of Black Engineers (NSBE) to be safe spaces that help her feel a sense of belonging. More specifically, she mentioned:
The president of NSBE is an African male and just seeing another African actually taking charge of that aspect of things. And ASO, which is African Student Organization, just being able to be with those people too. Having places like that to feel connected. Cause a lot of times, like I can find places to feel Black. That’s not too, it’s hard but it’s not too hard. I can find, like Wisdom, I found something like that. I can find BSU. I can find places to feel Black. But it’s not that many places I can find to be African.

You can see here how important safe spaces were for Glory as she needs spaces to feel closer and connected to her identities and resist systems of oppression that make her feel unwelcome, alienated, and less than. Additionally, spaces like ASO were important for her in developing positive feelings of belonging and community because she could not rely on or establish those perceptions of belonging or peer relationships due to oppressive systems in ECS. These findings were consistent with Renn and Arnold’s (2003) research on college student peer relationships and how space matters to student’s academic success.

More broadly, Amber supports the idea of creating safe physical spaces for Black women in ECS, deeming it her number one recommendation for institutions to have “some type of space to come to and talk about any racial and gender issues concerning our race and realize that it’s normal and that you can still be in computer science.” For Sawyer, safe spaces were essential and one of the vital necessities that many STEM spaces lack. NSBE and SWE were the two places she identified as her safe spaces where she felt she could turn to. She feels it is important that institutions provide physical safe spaces, “not even just for Black women but for women in general if you want them to succeed.”

Summary

In short, this chapter included the purpose, the research questions, and the findings of the study revealed salient themes regarding Black undergraduate women in ECS at Elmwood University that parallel stories that uncovered their shared sense of alienation, exclusion, and invisibility in the ECS majors. Additionally, the results revealed racial and gender
discrimination from faculty and peers, positive and negative peer and student-faculty interactions, the importance of shared-identity and cultural awareness, the perseverance and self-reliance they depend on, and lastly, their engagement and involvement in student clubs and organizations as a means of developing a sense of belonging. At the start of the next chapter, I present in more detail the descriptive details of thematic results regarding their double bind in ECS.
Chapter 5: Discussion and Conclusion

This qualitative research study explored the experiences of Black undergraduate women in engineering and computer science (ECS) fields at a large public university and how peer and student-faculty interactions shaped those experiences. Detailed in the previous four chapters, I introduced and justified my study, a review of pertinent literature, thorough description of my grounded theory research methods, and a descriptive interpretation of my results. Now, in this last and final chapter, I divide my discussion and conclusion into four sections. The first section will include a summary of my study and description of the systems of oppression and institutional racism, sexism, and misogyny in ECS and a descriptive review of the thematic categories narrated in Chapter 4. The second section then uses the empirical and conceptual literature to interpret the patterned results presented in Chapter 4 to evaluate the research questions that guided this study. Following this discussion, the third section discusses implications of the study’s findings for policy and practice. Finally, the last section offers recommendations for future research.

Overcoming Systems of Oppression in ECS: Summary of the Study

The purpose of this grounded theory study was to explore the experiences of Black undergraduate women enrolled in an ECS degree program at Elmwood University. Using a mixed criterion and snowball sampling strategy, I conducted one focus of 5 participants, and 6 individual semi-structured open-ended interviews, using a concurrent data collection-analysis approach, with Black undergraduate women, employing a constant-comparative method in the data analysis process. Doing so offer me an analytic structure to apply as I gathered and made sense of the rich information I collect in the field. I critically examined the experiences of Black undergraduate women in these fields and hope to present stakeholders and institutions of higher of education with proactive strategies and actionable recommendations for developing effective
policies, programs, and services that support at entry through successful graduation. Ultimately, the goal of this study was to develop a theory to determine how peer and student-faculty interactions shape the undergraduate learning experiences of Black women in ECS fields.

I conducted this study, in large part, to add to the dearth of literature on the experiences of Black women in STEM fields and bring awareness to the underrepresentation and disproportional rate of Black women pursuing, persisting in, and earning bachelor’s degrees in ECS fields. Much of the lacking literature on Black students in ECS is consistently cited as one of the key areas for improvement, yet what always goes unnoticed, unheard, or ignored are how Black women in these fields are and have historically pursued these fields at lower rates but have resisted, persisted, and completed their courses of study. As cited earlier in the study, a little over 26 percent of undergraduate engineering degrees were awarded to Black undergraduate women despite the fact that they virtually outnumber their male peers on college campuses by 2 to 1 (Slaughter et al., 2015). Moreover, the lack of literature on Black women’s experiences in these fields typically focus on Black students compared to their white students or women compared to men. However, few actually address intersectionality and STEM and how Black women are subject to the complex interplay of sexism and racism, known as their double bind which was defined earlier as a set of “unique challenges minority women [face] as they simultaneously experience sexism and racism in their STEM careers” (Ong et al. 2011, p. 175).

Summary of Thematic Patterns

The thematic patterns presented in Chapter 4 included: (a) a shared sense of alienation, exclusion, and invisibility, (b) racial and gender discrimination, (c) a complex mix of faculty and peer interactions, (d) identity and culture, (e) perseverance and resilience, and (f) student involvement and sense of belonging. Here, the first theme revealed how all Black undergraduate women participants described and recounted times when they felt alienated, excluded, and
invisible by their faculty and peers against a backdrop of an unwelcoming, gendered ECS culture and climate. As Glory explained it, the very few Black women who exist in these ECS degree programs often feel ignored, invisible, invalidated, and “like an alien from another planet” because they see do not see others in their faculty or peers who look like them or share the same gender or culture. The second theme on race and gender discrimination revealed what we already know, that Black women’s double bind in ECS find them at the center of racial and gender discrimination within systems of oppression. Here, participants shared encounters with racial and gender microaggressions from non-Black faculty and peers, resisting negative Black women stereotype threat—those negative Black women stereotype, like “angry Black woman,” “dumb Black girl,” or “single Black mother”—that overshadow Black women and exacerbates their troubling double bind in ECS.

In addition to resisting stereotype threat, those negative stereotypes attached to Black women, the third themed pattern revealed that shaped Black women’s experiences. Salient findings were that shared-identity—in terms or shared race, shared gender, shared culture, and more—was the single most important thing for all participants. While navigating racialized, gendered, and an unwelcoming ECS culture and climate, it was important for participants to see, have access to, and learn from faculty who shared their Black, African, and/or female identities. Collectively, all participants shared parallel stories and feelings about being taught by a Black male or female professor because, as Makasa explained, to see “a professor who looks like you—a Black person—it’s really, really encouraging, empowering and just indescribable . . . it’s beyond.”

The fifth thematic pattern revealed that, despite Black undergraduate women’s alienation and exclusion and lack of belonging and investment by faculty and peers, participants developed
perseverance to persist by being self-reliance, using family as a source of motivation, embracing thick skin, and seeking the help of mental health professionals, advisors, and counselors on campus. Lastly, the fifth theme revealed that Black women participants often participated in various student clubs and organizations to fill the void in their sense of belonging and to resist various racial and gender microaggressions that they typically face within ECS spaces. For instance, for the sake of shared identity, some participants admitted to joining he likes of NSBE, SWE, and ASO and academic and social events designed to help students socialize and develop a sense of belonging.

Using BFT in this study as a lens to understand Black women’s experiences in relation to sexism, class oppression, and racism, in addition to Crenshaw’s (1989) concept of intersectionality to examine their intersectional identities while addressing the broader social and systemic oppressions against a backdrop of a competitive and challenging STEM curriculum, I was able to confirm what we already know, and that is that Black women are at the intersection of an engineering/mathematics identity and a socially constructed racial and gender identity.

Research Questions

With a sense of the overarching patterns from results of data analysis, I interpret the study’s two research questions in light of what we know from the empirical and conceptual literature. Specifically, I discuss the following research questions.

1) What are Black women’s undergraduate experiences in ECS fields at a large urban public university?

2) How do peer support and peer interactions shape Black undergraduate women’s experiences in ECS fields?
Using BFT and intersectionality, I was able to interpret my findings as I evaluated my first research question: What are Black women’s undergraduate experiences in ECS fields at a large urban public university? Given that Black women experience discrete and overlapping oppressions linked to their race and gender in unwelcoming gendered ECS environments, BFT helped me to understand their struggle in these fields. BFT was employed for this study as construct because it demonstrated how Black women remain one of the most oppressed groups in America (Collins, 2000; Crenshaw, 1997; Davis, 1998; hooks, 1982). Black feminist thought’s main goal is to resist oppression in area and practice, and where else other than in ECS spaces do race and gender pose issues for Black women? In connection with their intersectionality in STEM, Black women experience overlapping biases and oppressions stemming from being Black and a woman in the U.S. (Carbin & Edenheim, 2013). Additionally, these frameworks helped me to explore and analyze how a complex mix of positive and negative peer and student-faculty interactions shaped those experiences against a backdrop of racial and gendered oppression and discrimination.

Ultimately, the overarching purpose of Black feminist thought is to resist and dismantle systems of oppression in both practice and research in higher education by uncovering their experiences. Moreover, in connection with their intersectionality in STEM, this concept posits that Black women experience intersecting oppressions due to being both Black and female in the U.S. (Carbin & Edenheim, 2013). Thus, using BFT and intersectionality as multi-theoretical approaches helped inform me of a rich understanding of the systemic oppression, racism, sexism, and misogyny that exists in unwelcoming ECS environments historically dominated by White and Asian men (Brown, 1997; Charleston, Adserias, Lang, & Jackson, 2014; Johnson, Brown,
Carlone, & Cuevas, 2011; Jackson & Charleston, 2012; Malcom, 1996; Margolis, Goode, & Bernier, 2011). Additionally, these frameworks helped me to explore and analyze how a complex mix of positive and negative peer and student-faculty interactions shaped those experiences against a backdrop of racial and gendered oppression and discrimination.

I also used Black feminist thought to understand Black women’s experiences in relation to sexism, class oppression, and racism, and Crenshaw’s (1989) concept of intersectionality helped me examine their intersectional identities while addressing the broader social and systemic oppressions faced by Black women living with multiple marginalities in the ECS fields. With respect to the first research question that guided this study related to the experiences of Black undergraduate women in ECS fields at a large urban public university, we can say that Black undergraduate women in ECS encounter—often overlooked and undetected—stress, anxiety, and/or racial battle fatigue. Regarding the two main concepts of Black feminist thought, resilience and persistence, the study revealed that all Black women participants demonstrated academic resilience and persistence within their educational journeys, which I discuss in detail below.

**Black Feminist Thought and Construct of Academic Resilience**

All participants in the study revealed similar and parallel stories of resiliency, struggle, frustration, and disappointment in being untapped and underrepresented in their majors and sharing a sense of alienation and exclusion, experiencing discrimination that is rooted in systems of oppression at the intersection of race and gender and encountering a complex mix of positive and negative interactions with faculty and peers. Consequently, BFT (Collins, 2000) is used in this study to help conceptualize the fact that a combination of participants’ race and gender and past histories generate distinctly different experiences than their non-Black peers that often call for them to develop academic resilience to persist. However, despite expressing frustrations in a
lack of shared identity in peers and faculty, overcoming cultural barriers within and outside of their own racial, gender, and cultural groups, persevering through resilience, and relying on student involvement and engagement—like student clubs and organizations and minoring in Africana studies—to resist the oppressive racialized and gendered systems in ECS, all 11 participants demonstrated how unstoppable they are in the face of adversity associated with double bind in ECS. Their academic resilience to resist feeling alienated, excluded, racialized and gendered, and underrepresented—all stemming from systemic oppressions and institutional racism, sexism, and misogyny, was evident and demonstrated in out participants ability to stop and remember that you have to “believe in yourself, cause no one else will.” It was also revealed that participants felt they had to be self-reliant by creating “your own security with yourself” when the faculty and peers around you do not look like or share the same identity as you.

Additionally, participants felt their parents and family sources instilled security and motivation to survive and push through the racial battle fatigue that manifested in the forms of stress, anxiety, and imposter syndrome. Like Cathy who credits her parents for modeling resilience and perseverance through their struggles with racism and adversity and teaching her that there is no ceiling and that she can accomplish anything is she so pleases. And, like Bella who sought mental health and wellness services on campus—in the form of the one and only Black woman therapist—to help her understand her stress and anxiety and to resist the systems of oppression and institutional racism, sexism, and misogyny in ECS that challenge her mental state and motivation to persist.

Lastly, academic resilience was revealed in participants’ ability and willingness to seek and work with mental healthcare professional on campus, as well as academic advisors and counselors who provided guidance and support along the way. Ultimately, you can see how
Black undergraduate women in this study extended resiliency beyond traditional or conventional definitions and found ways to resist oppressions and institutional racism and sexism by believing in themselves against all odds, developing securing and confidence in oneself, embracing self-reliance and support of family, mental health professionals, and advisors/counselors along the way.

**BFT and Black Women’s Persistence in ECS**

As a result of the Black undergraduate women’s resiliency in this study, many persisted through their program, having successfully graduated by the close of the study. Many of the participants explained how their motivation to persist in their majors and graduate was a result of the resiliency they gradually developed within themselves and their families. Overcoming barriers associated with the race and gender in these fields serves as motivation to continued pursuing their academic journeys. Additional examples of their persistence were demonstrated in, despite their lack of belonging and racial and gendered microaggressions, they were able to pass their courses, often by teaming up and joining forces with a small peer-group that frequently lasted their entire college stay. Collectively, and against a backdrop of perceived stereotypes associated with their intersecting identities as Black women, all 11 participants expressed the experiences of being one of the most underrepresented populations in their major, almost always identifying as “the only Black person” or “the only Black girl” in their ECS classes, yet their persisted, representing how unstoppable they are in their educational pursuits. Additionally, they all aggressed that the ECS climate and culture in all of their majors was clearly unwelcoming to women and even more ostracizing to Black women, which is a salient factor that contributes to their shared sense alienation, invisibility, and exclusion from peers and faculty.

Ultimately, being “the only Black person or woman” in almost all of your STEM academic courses, resisting Black women stereotypes like the “angry Black girl” or “dumb Black
girl,” being brushed off by faculty and peers who do not share your race, gender, or culture, and having to be self-reliant and embrace safe spaces outside of ECS all contribute and point to the issues that belong to Black women students—contrary to what many faculty and higher education professionals have assumed. The challenges of structural racism, sexism, and misogyny are the contributing factors and are to blame in this unequal and inequitable fight to achieve academic success in ECS.

Pertinent to this study, all 11 participants unquestionably found themselves in negotiating their multiple identities and double bind that challenge and serve as barriers to Black women in ECS. Almost all participants agreed that severe lack of Black and Black women representation in both faculty and student populations in ECS at Elmwood University was connected to longstanding structural racism and sexism in STEM. Based on these systemic factors that work against the representation, satisfaction, and success of Black undergraduate women in ECS, the major themes that emerged were Black women’s underrepresentation, feelings of invisibility, an unwelcoming climate and culture, and a shared sense of alienation. While the percentage of Black women pursuing ECS careers remains stagnant, they do exist—and they matter. We have heard stories about Black women navigating unwelcoming gendered ECS environments, feeling like wasted and untapped potential by faculty who “would rather invest in [their] White or bright peers” and who have shared negative peer and student-faculty interactions that have ultimately shaped their academic resilience and perseverance, rendering them unstoppable in their pursuit of an equitable education.

**Peer Support and Interactions and Black Undergraduate Women Experiences in ECS**

When we consider the second research question related to how peer support and interactions shape Black women’s experiences in ECS fields at a large, urban public university, we can see that participants’ accounts of their experiences slightly echoes what limited scholarly
literature already tell us about the how peer support and interactions lead to positive outcomes. Through Astin’s (1993) Input-Environment-Output (I-E-O) model, we can see that Black undergraduate women encounter experiences in college that serve as elements of the peer environment and affect student growth and/or change. For instance, their feeling alienated, excluded, and ignored by peers, specifically male peers, have shaped negative through thoughts and feelings about their ECS identities. According to Chickering and Reisser (1993), student communities, as well as the friendships and peer support groups students develop in college, shape how student development their identity. This is consistent with Mary and Makasa’s tactic of teaming up and joining forces to resist oppressive systems that alienate and exclude them and Glory’s reasons for minoring in Africana studies to surround herself with others who share her identity to develop a friendship group. Moreover, this connects with Tinto’s (1993) Student Departure Model (SDM), which suggests peer group interactions and extracurricular activities, like clubs and organizations, help students form supportive social systems that promote student integration.

It is important to note that of all factors, peer interaction has the strongest “predictive capacity for student outcomes, surpassing, by a considerable extent, the other factors” (Moran & Gonyea, 2003, p. 14), and parallel to Astin’s (1993) conclusions that peer interactions during undergraduate years are deemed the most prominent source of influence on student growth and development. But what does that say about Black women in unwelcoming, gendered ECS fields that do not offer them the same peer interactions as their White and other privileged peers? While these models are helpful in understanding—on the surface—how peer and student-faculty interactions shape the experiences of Black undergraduate women in ECS fields, they do not interrogate how systems of oppressions, like racism, sexism, and misogyny, contribute to Black
women’s underrepresentation and work against them in their pursuit of developing those peer networks to begin with. In other words, the more these models explain the stronger social integration, student engagement and involvement, the more likely students will succeed and achieve positive outcomes. However, they fail to address or account for how systems of oppression and institutional racism, sexism, and misogyny within ECS fields and higher education as a whole shape Black women’s development of meaningful social networks, friendship groups, and/or peer-group interactions.

**Cultural Barriers between Black American and African Students**

With respect to the theme of cultural issues between Black Americans and African immigrants, we can also see how the simmering animosity and/or lack of cultural awareness even between Black American and African immigrant students can be linked to intersectionality and STEM, more specifically to the institutional oppressions that may even pit these students against each other. In other words, recognition and praise seems to privilege “Black excellence” that may not extend to all Black students and exist appears to be an overall larger cultural issue. According to Carson (2004), Black Americans and African immigrants may fall victim to fallacies, stereotypes, and biases about each other and that have eclipsed strained relationships. For instance, African students has biases against Black Americans, deeming them “of lower social class” while Black American students referred Africans as “less civilized.” This notion of Africans feeling Black Americans are lazy was consistent with Mary’s account of hearing other African ECS students discuss the clash between Africans and Americans and “what African Americans are doing wrong and what Africans are doing right,” and “how Americans are lazy.” You can see, in these patterns, how broader racialized systems of oppression shape relationships between these two groups—with educational institutional and schooling systems, economic and
social structures, and media portrayals generally influence what these two groups believe about each other.

**Student-Faculty Interactions and Black Undergraduate Women Experiences in ECS**

While this study did not directly explore student-faculty interaction, a set of clear and compelling patterns related to how student contact with faculty shaped the experiences of Black women in ECS fields emerged from interview with participants. In fact, participants revealed negative, frequently destructive, interactions with faculty that ultimately shaped their motivation, persistence, and overall feelings of belonging in their major. As discussed, Serena felt faculty in ECS treated Black students, including Black women with a lack of investment and interest and felt they “obviously” do not have their best interest in mind, compared to their White counterparts, which is her argument for hiring more Black and Brown Faculty of Color. She argued that “Black teachers always seem to guide you down the right path” and were more caring instead of going out of their way to tease her or show a lack on investment due to her race and/or gender. These same feelings were also shared among participants like Amber, Glory, and Zaria who explained that being teased by faculty for not knowing or understanding material they have yet to go over has caused them to shy away from relying on faculty members altogether, simply to avoid the negative reactions that other “privileged” students receive without exception. Moreover, these negative feelings of being brushed off and told to not focus on being a “Black engineering” student, like in the cause with Camille, all shaped these negative feelings, not only about themselves, but about their potential future, as they are also underrepresented and experience the double bind of racism and sexism in an already male-dominated environment.

In addition to destructive interactions with faculty that ultimately shaped their motivation, persistence, and lack of belonging, all participants shared frustrations and discouragement with the complete absence of Black, female, and other Faculty of Color in their majors. The
inequitable treatment is consistent with the literature and the ultimate forces at hand, which is that non-Black faculty serve as potential barriers to Black undergraduate women’s academic experiences in ECS. This form of systemic oppression manifests through their male privilege and lack of investment that is ultimately—and blatantly—modeled to others who do not share their darker skin completions, female identity, cultural identity, or simply their multiple intersecting identities.

Essentially, these student-faculty interactions are directly connected to the institutional racism, sexism, and misogyny that exists in the very fabric of higher education and the larger STEM global workforce. Some participants felt as if they could not express multiple parts of their identity, whether it be tied to their race, gender, or sexuality. For instance, in Camille’s case, she was explicitly told that striving to be a successful Black woman engineer was an example of her being “too worried about the wrong things.” The blatant lack of investment, inequitable treatment, and “brushing off” of Black women and communicating to them that striving to be a successful Black woman engineering is “worried about the wrong things” (meaning they should somehow eliminate their Black woman identity from the equation and maybe they will be welcomed to the “boy’s club”) all strongly communicate that to Black men and women that their race, gender, culture are not welcome and communicate that they are ignorant and incapable of being successful in a STEM career (Martin, 2013).

In addition to systems of oppression in higher education and the STEM workforce that have shaped and continue to shape the experiences of Black women students in ECS, it has become clear that the institutional racism, sexism, and misogyny that percolate deep in the climate, culture, and pedagogy of ECS consistently find Black women in a double bind. Their intersectionality in STEM are directly linked to their alienation, exclusion, lack of Black role
models, and shared lack of belonging is in conflict with her race and gender identities. Ultimately, it comes down to this simple notion that sums up how participants in this study felt about their place and sense of belonging in this major: It does not matter if they walk like them, talk like them, or study like them, Black women do not march to the same beat of their White, Asian, or Middle Eastern male and female counterparts. And, until institutions of higher education and the STEM professionals accept this reality, engage in meaningful dialogue about its racist and sexist culture and climate, strip away their deficit-based approaches, and embrace a more culturally-relevant and culturally-responsive pedagogy, then deeply seeded systems of oppression and institutional racism, sexism, misogyny, as well as male privilege and exclusion of Black students, will continue to shape their experiences and impact the disproportionate percentage who persist and achieve success in their ECS careers.

Implications for Policy and Practice

The main themes that emerged from data analysis have several implications for practitioners and institutions of higher learning to consider. These implications could have provided better insight on the challenges Black undergraduate women experience in ECS at 4-year institutions. The findings of this study were used to make the following three recommendations for stakeholders and institutions of higher education to consider when developing strategies to improve the experiences and support of Black undergraduate women in ECS degree programs.

Implicit Bias Training

The first implication for policy and practice is for colleges and universities to create policy that requires all new and current faculty to undergo implicit bias training that discusses relevant issues of power, privilege, culture, and identity and how they exist within ECS fields. Through participants’ accounts, we have heard stories of the faculty biases and preconceived
notions, lack of faculty investment, faculty brushing off or dismissing Black women aside to cater to non-Black students, faculty advancing male privilege, to name a few. As Serena stated earlier, regardless of the lack of investment or poor treatment by faculty, it is important “to stick with it and push through it all,” and in order to survive and persist, “don’t let that stop you—let that be your motivation.” Serena’s words need to remind us that faculty have the responsibility to recognize and acknowledge how they too are a part of the institutional oppression that serves as barriers to Black women’s success, satisfaction, and persistence in ECS fields. Given what we have learned, faculty serve crucial roles ECS fields and are directly responsible for the underrepresentation, alienation, exclusion, and racial and gendered discrimination of Black women in these fields. Though color-blindness or color-evasiveness, some faculty may not even recognize or acknowledge their own personal implicit biases that perpetuate negative treatment towards Black women in ECS—perhaps because they too may have been educated and trained in the same unwelcoming, gendered ECS spaces that were never really designed with them Black men and women in mind. Thus, it is vital for mandatory implicit bias training to be offered to new and currently faculty support of a diverse and inclusive community, I recommend implicit bias training and workshops for implicit bias awareness and mitigation.

**Increase of Black Representation**

The second implication for policy and practice is to focus expand the representation of Black faculty in ECS. Hiring practices should be revisited to determine how to best diversify the faculty pool increase representation of Black faculty and role models in ECS. There is a viable pool of Black and Brown candidates graduating from American colleges and universities from which to increase and expand academic diversity (Gibbs, Basson, Xierali, & Broniatowski, 2016) and participants like Serena have indicated that they know “qualified” Black and Brown men and women in ECS fields exist and are applying for teaching positions, it is just campuses like
Elmwood University and many others who have yet to make it a priority or offer strategic practices to fully diversify the faculty pool and representation. Also salient to the study were instances where all participants spoke on the importance of shared-identity and the power it has on Black students when they see themselves reflected in the faculty teaching their courses. As mentioned, participants who expressed having a faculty member who shared one or more of their identities also admitted to feeling “normal,” motivated, less invisible and more welcomed in their ECS environments. They explained that having access to faculty and peers that share the same skin tone, race, gender, and/or culture is important because it affirms or validates their presence. Collectively, all participants noted similar/overlapping feelings of belonging, acknowledgement, and empowerment of seeing Black peers and Black faculty who share their identity, noting how it provides them someone to whom they can relate and aspire or emulate. Students are shortchanged into molding their excellence behind someone else’s version of greatness, success, and leadership.

I encourage us to take a moment to recall Serena’s excitement from earlier when she stepped foot into her engineering materials lab and realized her professor was an African male. You cannot help but feel the excitement off the page as she describes the impact of shared identity. “It was the last thing I ever expected,” she remembered. I encourage you to now think about how non-Black and non-Students of Color who are privileged enough to have these very same feelings when they walk into a classroom every day. The motivation, empowerment, and sense of belonging it fosters in students is real—almost tangible—and it matters most for those who hardly get that occasion but only a few prized times in the sum of their educational experiences. Given the sentiments so far about shared identity, the question we should be asking is how are Black men and women supposed to succeed academically in unwelcoming, alienating
spaces when the very environment that promises to educate the masses was never designed for them to succeed in the first place and they have no one in those spaces who looks like them or shares their identity?

**Creating Safe Spaces**

The third implication for policy and practice is for the institution to build and promote safe spaces within ECS for Black women and other Black students to come together, be free, and feel comfortable being Black and/or a Black woman in their surroundings. On college campuses, safe spaces can be found in the form of a building, classroom, or even a formal group that is established on campus and seeks to provide safety, respect, and emotional security. Important to this study was the impact the focus group and one-on-one interviews had in helping participants realize they are not the only Black women in these programs and that their feelings were warranted and acknowledged. Participants shared that being in the presence of other Black women in their majors, sitting across from them in the same space, was so validating. They also highlighted feelings described as “supportive,” “inspiring,” and “long overdue” and many talked about how “freeing” it felt to use the space to talk and express their feelings, frustrations, fears, and disappointments. In essence, the focus group and interviews served as a safe space and allowed them to discuss their muted experiences in their programs and in college. Moreover, throughout the study, the participants expressed how much they enjoyed and needed to be a part of a safe space similar to the focus group where, for many, it was their first time being in the same room with other Black women students in ECS and the first time having the opportunity to have their voices heard and share and talk openly about any barriers or challenges with others whom they relate to or share a form—or multiple forms—of identity.

Additionally, safe spaces dedicated for NSBE, SWE, and other racial, cultural, or grander groups can help Black women and other Students of Color reduce anxiety, stress, and other
mental-health related issues and offer a place to resist the racial and gendered discrimination and oppression that happens to them almost exclusively. The fact that most participants revealed or shared experiences racial battle fatigue, proves how chronic anxiety can take a toll on our emotional and psychological health. Of all the participants, Bella reinforced the notion that having access to a Black woman therapist was the safest she felt on campus and the one place she felt she could turn to manage her conflicting feelings of anxiety, imposter syndrome, and an overall sense of wanting to give up at times.

**Shared Identity-conscious Mentoring**

The fourth implication for policy and practice relates to the need for shared identity-conscious mentoring for Black women, Black students, and other Students of Color and marginalized groups. Given Black women’s underrepresentation, shared feelings of alienation and invisibility, and overall lack of belonging in their ECS majors, most participants expressed instances of racial battle fatigue, which is defined as the “cumulative result of a natural race-related stress response to distressing mental and emotional conditions. These conditions emerged from constantly facing racially dismissive, demeaning, insensitive and/or hostile racial environments and individuals” (Smith, 2018). Coupled with challenges and oppressions attached to their female identity, Black women’s racial battle fatigue often can negatively impact their motivation and decision to continue pursuing a career in STEM, even STEM faculty positions in higher education (De Welde & Laursen, 2011; Turk-Bicakci, Berger, & Haxton, 2014). Therefore, it is important that colleges offer and promote structured ongoing support from qualified Black faculty, role models, and professionals on campus who can connect with Black women on a deeper level, help them negotiate and understand their multiple racial and gender identities. Moreover, Black mentors could act as a buffer against the potentially detrimental effects of Black women’s racial and gendered ECS experiences, while institutional support for
such efforts could help universities achieve higher recruitment, retention, and graduation rates for historically underrepresented Women of Color.

**Black Women Participation in Research and Student-Faculty Research Experiences**

The fifth implication is connected with race- and gender-conscious mentoring and that is facilitating the participation of Black undergraduate women and Black faculty in student-faculty related research opportunities. Given the explicit lack of Black role models—notably Black women role models—in STEM, especially ECS, providing Black women with opportunities to conduct student-faculty research with Black faculty using culturally relevant and culturally responsive curriculum would help address issues related to their shared sense of alienation, exclusion, and invisibility, racial and gender discrimination, a complex mix of faculty and peer interactions, lack of shared-identity and culture, perseverance and resilience, overall lack of sense of belonging.

**Facilitation of Black Women in Research on their Intersectionality in STEM**

A sixth implication for policy and practice is that colleges and universities do what they can to facilitate Black women involvement in this type of research that uncovers their unique racialized and gendered experiences in isolation alone to paint a holistic picture of not only their struggles, but the positive experiences associated with their academic and social experiences in STEM. Without facilitating these opportunities, Black women and other marginalized racial and gendered groups will continue to be untapped, underrepresented, and voiceless in these fields and systems of oppressions and institutional racism, sexism, and misogyny will continue to flourish and hinder their representation.

**Cultural Competence and Culturally Relevant Pedagogy for Social Justice**

A seventh implication for policy and practice is for higher education professionals to adopt, develop, and exercise cultural competence within diverse and homogenous educational
communities. Cultural competency, as Green (1999) defines it, is the ability “to deliver professional services in a way that is congruent with behavior and expectations normative for a given community and that are adapted to suit the specific needs of individuals and families from that community” (p. 87). Regarding Black undergraduate women in ECS who are underrepresented, alienated, lack professional academic support and investment, and often negotiate negative feelings of belonging, resulting low retention, persistence, and graduation rates, working to make coursework and extracurricular experiences cultural relevant would meaningfully connect Black women in these fields to their academic work and professional preparation. Thus, faculty can use cultural competence to develop the interpersonal skills needed to understand, work with, and serve Black women.

More specifically, faculty can adopt Goodman’s (2013) effective Cultural Competence for Social Justice (CCSJ) model that can be used to help practitioners focus on creating opportunities for faculty to be more informed and equipped on the best practices regarding teaching, mentoring, and supporting Black women as the challenges and needs of this particular population differ compared to their non-Black counterparts. Opportunities can be in the form of professional development and training opportunities, especially in the realm of teaching them how to be more culturally competent in their teaching. Essentially, universities can adopt a more culturally relevant and responsive approach to pedagogy that allows for faculty to use this method to acknowledge, connect with, and encourage each student to relate course content to their cultural context. Following CCSJ, faculty will be able enhance, develop, and use the five key components of this model to: (a) be self-aware of social identities, cultural influences, prejudices, stereotypes, and biases, (b) understand and value others, including their social identities, cultures, and perspectives of others, (c) be knowledgeable of societal inequities and
how they exist on multiple cultural, institutional, and structural levels, (d) develop skills to interact effectively with racially and culturally diverse student groups, and (e) develop skills necessary to foster equity and inclusion.

**Increase Black Women-focused Research**

My eighth implication is for researchers to actively promote and commit to research that places Black women in STEM at the forefront and exclusively addresses their experiences, treatment, and underrepresentation in isolation alone and not in comparison to Black men or women. The gap in literature and research on Black women and their double bind in ECS fields attests to the critical need for researchers to conduct additional qualitative, quantitative, and mixed method studies, produce more peer-reviewed journals and publications, and increase the access to data related to the racial and gender barriers of Black women, women, and Women of Color in education and ECS fields. Doing so will grant researchers opportunities to reference sources, articulate data, and elevate discourse on their lack of representation, alienation and exclusion, racial and gender barriers in these fields, while simultaneously increasing credibility when engaging in dialogue on issues like race, gender, identity, and/or opportunity gaps. In essence, devoting research to Black women, women, and Women of Color in ECS fields would help uncover additional factors contributing to attrition and retention, pinpoint gaps in current research and literature, and offer recommendations and strategies for refining pedagogical, institutional, and systemic efforts.

**Incorporating Families of Black Women into Research**

My ninth and last implication for practice is to increase the incorporation and invitation of the families of Black women in ECS fields into their academic and research work on campus. Often, we hear about the lack of STEM awareness in Black families and the lack of familial involvement due of the foreign nature of these fields, which is itself a function of structural
racism that excluded Black parents and families from educational systems. Given that historical systems of oppression and institutionalized racism, sexism, and misogyny have prevented and deterred Black men and women from pursuing STEM fields, it is clear why the families of Black women need to be a part of their academic and research work. They are critically missing in our work in higher education to mitigate effects of institutionalized racism and race- and gender-based systems of oppression and could be one step closer to also achieving a more culturally-relevant and culturally-responsive pedagogy needed to resist and dismantle the racism, sexism, power, and patriarchy—to name a few—in higher education.

**Recommendations for Future Research**

This study explores the experiences Black undergraduate women in ECS and how their peer and student-faculty interactions shaped their experiences at a large urban public institution. The population size was relatively small, consisting of 11 research participants. Each participant’s story revealed significant experiences and perceptions in an effort to answer the research questions that guided this study. Based upon research findings, five major themes emerged from the data that were deemed significant in participant’s experiences in ECS: (a) a shared sense of alienation, exclusion, and invisibility, (b) racial and gender discrimination, (c) a complex mix of faculty and peer interactions, (d) identity and culture, (e) perseverance and resilience, and (f) student involvement and sense of belonging. This study’s findings align with and reinforce limited research studies that have been previously conducted, yet there are still unanswered questions and areas that require future research. The following are my recommendations for future research:

1) A first recommendation is to extend the sample size of my study. I was limited to 11 participants, where 5 participated in a focus group and 6 participated in personal, one-on-one interviews. Four of the 5 participants in the focus group continued on to join the
interview. Given the small sample size, I feel expanding the sample size could strengthen the study and further facilitate transferability of findings from this study. With Black women’s underrepresentation, I recommend interviewing 1 to 3 additional participants from all campuses within the university system to which Elmwood University belongs, which to make for a robust study, rich with diverse stories. Further, inviting Black women from research-intensive universities will help to reveal how these patterns of racism and sexism unfold in these institutional contexts and add the richness of voices in the stories of Black women’s lived experiences.

2) A second recommendation for future research is to explore the racial and gender experiences of Black women faculty in ECS to identify barriers/challenges and develop best practices for mentoring and support that can transfer down to the support of prospective Black women professionals. Black women faculty experiences in ECS. During the interviews and data analysis stage, participants talked about the overall lack of Black female faculty and how important and powerful it would be to be taught by a Black female engineer or computer scientist.

3) A third recommendation for future research is to conduct a longitudinal study highlighting the experiences of Black women all the way through graduation. Future research on their experiences would benefit from a longitudinal study and provide practitioners and policymakers with a more holistic and comprehensive understanding of the barriers, challenges and successes Black women experiences in ECS fields.

4) A fourth recommendation is to conduct future research on Black women using Black feminist thought and intersectionality to continue advancing the narratives about how the experience their race, gender, and other overlapping identities in racialized and gendered
environments. This study can be expanded to include 20 to 30 participants from additional campuses to dig deeper into this research.

5) Lastly, a fifth recommendation for future research is to conduct the same or similar study but employ Yosso’s (2005) Community Cultural Wealth (CCW) theoretical framework to shift discourse about Black women’s educational inequality from deficit perspectives to those that recognize, acknowledge, and promote the untapped assets and diversity they bring to STEM. Yosso posits that CCW is an “array of knowledge, skills, abilities and contacts possessed and utilized by Communities of Color to survive and resist macro and micro-forms of oppression” (p. 77) and include the following six forms of capital: aspirational, navigational, social, linguistic, familial, and resistant capital. Since CCW represents a student’s accumulation of their unique forms of capital they can and often use to survive and persist unwelcoming educational spaces, researchers and faculty can use her framework to disrupt the oppressive practices we have learned that oppress, silence, and marginalize Black undergraduate women unwelcoming, gendered ECS environments. For instance, they can use aspirational capital to learn how Black women “maintain hopes and dreams for the future, even when facing barriers, whether real or perceived” (p. 77). They can employ linguistic capital to uncover the “intellectual and social skills attained through communication experiences in more than one language” (p. 78) and this is especially important to African immigrant women who may or may now speak another language. Additionally, researchers can use familial capital to determine how Black women use the “cultural knowledge nurtured among family that carries a sense of history, memory and cultural intuition” (Yosso, 2005, p. 79; Delgado-Bernal, 2002). Researchers can also use social capital to further explore how Black women use
their network of people and community resources to persist and succeed academically. Navigational capital is another form or wealth in CCW that can be used to decipher how Black women’s ability to maneuver through social institutions. And, lastly, researchers can use resistant capital to highlight Black women’s “knowledge and skills fostered through oppositional behavior that challenges inequality” (Yosso, 2005, p. 80).

**Researcher’s Reflection**

As a Black, gay male in academia, I now write this portion of the dissertation with a complete different set of eyes and frame of mine. Not that pandemics are something new or that Black men and women were being killed at disproportionately higher rates than any other race in America until this time, it did not occur to me that I would be ending this study against a backdrop of a global pandemic, where over 400,000 COVID-19-related deaths worldwide have been reported, in addition to an ongoing series of protests in response to the systemic racism and excessive police brutality and killings of unarmed Black men and women. First, the quarantine, then the constant reminder every day in the media that racism, color-evasiveness, and White privilege all very much still exist, and a large portion of world still hates and has very low expectations of Black people. Through it all, I can say that writing this dissertation study on Black women in ECS fields has been a beautiful and transformational experience, taking me on a journey of growth and self-reflection. Embarking on this journey was not an easy one. Given the mental and physical stress, I feel it takes a village to survive 3-year doctoral program, produce a dissertation study, and work full time. On many occasions, have I had to rely on the strength and support of my family, partner, cohort, friends, mentors, participants, and others to motivate and empower to me persist in this journey.

Throughout this experience, I have felt lost, discouraged, depleted, and even insecure about my ability to add to the conversation of Black women. However, I thank the amount of
reassurance and support that I received from those in my corner, including the Black women participants who thanked me countless times for providing them a voice in their lonely and unforgiving experiences in these fields. I trust my work will add to the conversation about Black women in ECS fields and offer relevant recommendations for research and practice. Ultimately, unmuting the voices of Black women students in ECS—voices that have been ignored and overlooked in research—motivated me to be purposeful in data collection and analysis and applaud them in the unfortunate resilience and perseverance that they have to develop in their academic ECS journeys in order to combat systemic oppressions and institutional racism, sexism, and misogyny.

**Reflection on the Positive Sides to the Chaos**

Taking all of this into consideration, I can say there are three positive sides to the chaos. One, it sheds light on Black women’s intersectionality in STEM and the oppressive systems that hinder their success; two, the chaos has helped me learn more about self-reflection and my connection to the study; and three, the feedback that I have received on how this study reinforces the overall importance of the study and giving Black women a voice in spaces where they are not present to simply muted. Shedding light on Black women’s intersectionality helps to unveil and expose the deeply entrenched systems of oppressions and institutional racism, sexism, misogyny, patriarchy, and White privilege that result in their underrepresentation, alienation, double bind, complex mix of peer and student-faculty interactions, and more of Black women in ECS fields. It has also helped me to understand more about myself, my journey, and how these American systems of oppression have shaped my experiences of racism and homophobia in higher education. Additionally, this study, the pandemic, and protests have all helped me understand how I see myself, the lack of Black accessible and visible role models in my academic and professional careers, and the academic resilience and perseverance that I imbued in myself to
persist and resist oppressions. It is all one in the same system that was never really designed for me—or the Black women in my study—to succeed and thrive.

Lastly, the third positive side to the chaos is that, along the three-year journey in my doctoral program in educational leadership and policy studies, my research topic has and continues to be met with positive feedback, including those from the likes Black women, faculty, colleagues, mentors, practitioners, family, and more who all remarked on the importance and necessity of contributing to muted conversations and limited research and action related to Black women’s intersectionality in ECS fields. Since Black women continue to be missing from the literature, it is important that more research is devoted to this population, and with Black women students and Black women professionals at the forefront conducting these studies. Ultimately, all of the feedback that I have received speaks on the importance of highlighting the oppressive systems and institutional racism, sexism, misogyny, and more that play critical roles in the phenomenon of this study: Black women’s underrepresentation in ECS fields.

Reflection on the Importance of Student-Faculty Interactions and Shared-Identity

The initial goals of this qualitative grounded theory study were to uncover Black undergraduate women’s experiences in ECS programs and explore how their peer and interactions shaped those experiences. One result salient to the study that was not initially a part of the research questions was the influence of student-faculty relationships and how they shaped participant’s experiences. I originally thought that peer support and interactions would have the strongest influence of success, and earlier researchers indicated. However, pertinent to this study, outside of the peer-group relationships and those within their own cultural identity, it was the shared-identity with faculty (and some peers) that truly resonated, motivated, and empowered the participants in the students and had a direct link to increased feelings of belonging, investment, and overall satisfaction in their experience when they were taught by, mentored by,
or in the same space as a Black professional. Because they are often “the only Black person” in the majority of their classes, seeing someone who looks like them or shares some semblance of their multiple, overlapping identities in these unwelcoming, gendered ECS spaces, it gives them hope to continue when hope may be the last thing left for Black women students.

**Reflection on Black Women’s Racialized and Gendered Experiences as Part of a System of Oppression and Institutional Racism, Sexism, and Misogyny**

As initial data collection procedures and instruments unfolded, it became clearer that Black undergraduate women’s negative racialized and gendered experiences regarding their intersecting identities, peer and student-faculty interactions, sense of belonging, lack of ECS identities, and more, were more than just negative experiences. My study also helped me to realize that these themes of this study, a shared sense of alienation, exclusion, and invisibility, racial and gender discrimination, a complex mix of faculty and peer interactions, identity and culture, perseverance and resilience, and student involvement and sense of belonging, all point to the systems of oppression and institutional racism, sexism, and misogyny all stem from discriminatory institutions, structures and norms that are embedded in the very fabric of American society. Looking back now, after a few years, I can be honest with myself in that I undertook this study with a mild understanding of just how powerful systems of oppression are directly linked to the low representation, persistence, retention, and graduation rates of Black women students in ECS degree programs. It only took 17 years of college, nearly three college degrees, zero Black college faculty experiences and mentorship, 11 conversations with powerful, resilient Black undergraduate women in ECS, thousands of academic advisement sessions with first-generation, financially-disadvantaged Students of Color—and more recently, the multiple and explicit slayings of unarmed Black men and women in America.
My connection to Black women’s experiences in ECS. More on the idea of how this study on Black women’s racialized and gendered experiences in ECS connects with my experiences, I realize now, more than ever, that I share similar current and previous experiences of an alienation, exclusion, and discrimination due to my overlapping Black and homosexual identities. As shared earlier, I can count on one hand the number of faculty who share my multiple identities. I ask again, how is it that Black women, and Black students as a whole, lack role models in their academic and professional careers who can teach, guide, and offer an example of excellence to follow? Why and how is it that we often navigate and persevere through multiple decades worth of educational experiences following, emulating, and being “brushed off” by someone else version of excellence and success? Why are Black women untapped, underrepresented, and unstoppable in ECS fields? The goal of this grounded theory study has helped me answer these burning questions and achieve the initial goal of developing a theory on how peer and faculty-interaction shape the experiences of Black undergraduate women in ECS fields. To understand why Black women are untapped, underrepresented, and unstoppable in ECS—and why I and other black men and women experience similar racialized, gendered, and “othered” experiences—is because we have fought against institutional power, including societal institutions such as culture, housing, government, and education, and more that are all complicit in the oppression of marginalized social groups while elevating dominant social groups and status.

Higher education’s compliance in Black women’s intersectionality in ECS. In the context of ECS and higher education, Black women are underrepresented, experience alienation, exclusion, and invisibility, and lack access to Black role models. Institutions of higher education continue to remain complicit in the lack of investment and support of Black students and the
largely white, heterosexual, cisgender men who have shaped them as racists and oppressive institutions that privilege White men and exclude People of Color. Moreover, these institutions remain comfortable in their lack of efforts to advance the careers of Black women early on in their educational experiences and invest more energy in the mix of racial and gender microaggressions that dissuade them from achieving academic success and/or developing a sense of belonging in their ECS fields. When Black women participants say they are “the only Black person” in all of their classes and never seen or are taught by one Black professor, it is because institutions like Elmwood University remain complicit and content in advancing the careers of non-Black faculty—both full- and part-time—and failing to truly diversify the faculty pool. Colleges and universities may say they strive for diversity, equity, and inclusion—especially in their educational missions and values. However, most fail to follow through or embed such policies in their missions and institutional practices in a meaningful way. Over the course of 17 years and nearly three college degrees later, I still have yet to see or be taught by any Black faculty members, and it is this underrepresentation and lack of shared identity that deprives students like the 11 participants in this study, the opportunity to envision themselves as successful in their majors. To reiterate, higher education is complicit in the lack of visible and accessible Black role models and the underrepresentation and neglect of Black students in their respective academic disciplines.

Another example of how higher education is complicit in Black women’s racialized and gendered experiences in ECS is through the cultural barriers and differences that surround Black Americans and African immigrants. The potential simmering animosity between the groups, lack of cultural awareness and understanding, and biased perceptions of each other can all stem from the pressures inflicted on these groups from oppressive systems that pit them against each
other and allow for the “Black excellence” that some participants felt was only ascribed to African-born students and double invalidated their intersectionality, struggles, and realities. Moreover, the amount of resilience and perseverance Black undergraduate women have to develop in order to persist and survive their unwelcoming, gendered ECS environments is unjust and a direct result of the initialized racism, sexism, and misogyny that higher education has ever so be complicit in since the inception of education. Ultimately, it is importantly to call out and hold accountable to action institutions of higher education for their systems of oppression and institutional racism, sexism, and misogyny. We must not be complicit in just learning about Black women’s racialized and gendered experiences in ECS and then later turn a blind eye to their experiences of a shared sense of alienation, exclusion, and invisibility, racial and gender discrimination, a complex mix of faculty and peer interactions, identity and culture, perseverance and resilience, and student involvement and sense of belonging.

If anything, we must push the narrative back to what matters and that is to resist and fight against American systems of oppression and institutional racism, sexism, misogyny, patriarchy, and countless oppressions that hinder and dissuade Black women, Black men, and other marginalized groups from achieving the American dream. In the end, we must no longer accept being untapped or underrepresented, and just being unstoppable.
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Appendix A: Invitation to Participate in Research

CALIFORNIA STATE UNIVERSITY, NORTHRIDGE
Black Undergraduate Women in Engineering and Computer Science
Invitation to Participate in Research

Dear Ms./Mrs.,

I am writing to inform you about a dissertation study that is being conducted at [Elmwood University, a pseudonym] regarding the academic and social experiences of Black undergraduate women majoring in engineering and computer science (ECS). Deazell Johnson, a doctoral candidate, is conducting the study as part of the Ed.D. degree requirements.

The purpose of Deazell’s dissertation study is to explore how peer interactions shape the academic and social experiences of Black undergraduate women in ECS at a large, urban public institution. This study will add a dearth of knowledge regarding peer support and Black women in these STEM fields. Your role in this study would be to participate in one 90-minute one-on-one interview.

Any personally identifiable characteristics, such as your name, age, current work location, college/university, will not appear in the study. Participating in this study is completely voluntary and you may withdraw at any time.

Your time investment in this study is greatly appreciated. If you would like to participate, please contact Deazell at [email address redacted] or [phone number redacted]. Thank you in advance for considering participation in this study.

Best,
Deazell Johnson
Facilitator: 

Co-Facilitator(s): 

Date: 

Site: 

Participant Group: 

Participant Initials (Codes): 

I. Introduction/Background

Welcome and introduction: 
Good morning/afternoon/evening. Thank you for taking the time to come together for this focus group discussion with us today. The purpose of this discussion is to collect information for a research study that explores how peer interactions shape the academic and social experiences of Black undergraduate women in engineering and computer science (ECS) fields.

Format: 
Today’s session will follow a format that allows for everyone to share and contribute. First, we ask you to use the first initial in your first name and last name to identify yourself before you speak. This will allow us to attribute comments to you as we protect your confidentiality. We will not use your initials in any publishing report or publications, and we will redact your initials from transcribed interview files—this is for internal use only. Second, we ask you to respect what others share and allow them to finish their statements before sharing. Finally, you do not have to answer any question or participate in any way in any part of or the entire discussion.

Informed consent: 
I am sharing an informed consent form, which communicates the procedures, potential risks and discomforts for subjects, potential benefits to subjects, payment to subjects for participation, participation and withdrawal, and rights of research subjects. I ask you to review, sign, date, and return the form to us now.

Timing: 
Today’s session will last approximately 60 minutes. Are there any questions before we begin?
I. Interview Session

1. Please tell us your name, major, and motivation(s) for pursuing a degree in ECS.

2. I’d like to chat about your social experiences. Think back to when you first began to develop your peer network/peer social contacts and how they’ve evolved over time.
   - Now, please describe your peer network
   - How do you interact? How did they develop?
   - Describe the gender/racial make-up of your network/social contacts.

3. Do you belong to any undergraduate academic programs or participate in any peer mentoring, tutoring, student clubs, organizations, or societies related to engineering/computer science?
   - If so, describe those peer and social interactions.
   - Walk me through a time when your participation or involvement in one of these programs has helped you academically and socially?

4. Now, still thinking about your peer support and peer interactions and engagement in academic programs, student clubs, organizations, or societies:
   - How does these peer interactions and support shape your academic experiences?
   - How do they shape your social experiences?

5. Now, transitioning to your identity as a Black woman in ECS, describe any programs or activities within your College that help you develop a sense of belonging.

6. Are there any role models (faculty, staff, peers) who share your same identity (Black women)?
   - If so, describe that relationships and how it helps you academically.
   - If not, describe how the lack of that relationship affects you academically.

7. Can you share an example of a time when you felt racially excluded in any of the STEM courses, programs, activities, in your major?
   - If so, walk me through it step-by-step, describe what happened and reflect on it.
   - How did it make you feel?

8. Take a moment and please think and describe any unique challenges, oppressions, or roadblocks you feel have been directly related to your intersecting identities (Black + woman).

9. Suppose you had one moment to sit down in a room with the president of your campus and the dean of your college. What advice about would you give them about supporting Black women in engineering and computer majors?
Closing Questions:
I/we would like to give you a final opportunity to help me conduct my research. Before we end today, is there anything that I/we missed? Have you said everything that you anticipated wanting to say but didn’t get a chance to say?

Compensation:
As a thank you for your participation, I would like to offer each of you’re a $5.00 campus dining card to show my gratitude and appreciation for your participation in my study.

III. Debriefing

Finally, this is the end of the group process. I want to provide you with a chance to ask any questions that you might have about this focus group. Do you have any questions at this time? Thank you for participating in today’s focus group session. I appreciate your taking the time and sharing your ideas with me. I also want to restate that what you have shared is confidential and that I will follow steps outlined in the informed consent form to mitigate risk and protect your confidentiality. I will follow up with you all via email within the next couple of months to provide an opportunity for you to confirm if I have accurately interpreted and described the experiences and reflections you shared in the group process. Please feel free to contact me via email if you have any questions.

Thank you again for your participation.
Appendix C: General Interview Guide

CALIFORNIA STATE UNIVERSITY, NORTHRIDGE
Black Undergraduate Women in Engineering and Computer Science
General Interview Guide

I. Pre-interview Session: Introduction/Background

Welcome and introduction:
Good morning/afternoon/evening. Thank you for taking the time to talk with me today. Before we begin the interview session, I’d like to give you the opportunity to read and sign the Consent to Participate in Research.

Purpose of the interview:
This interview is intended to collect information for a research study that explores how peer interactions shape the academic and social experiences of Black undergraduate women in engineering and computer science (ECS) fields. During the interview, we will talk about your personal, academic, and social experiences, as well as any challenges faced regarding your intersecting identity as a Black woman in a STEM field.

Consent:
Please take a moment to review, sign, and date the written informed consent form. I’d be pleased to respond to your questions about the form.

Timing:
Today’s interview will last about 60 minutes. Before we begin, do you have any questions?

II. Interview Session

Black Feminism & Intersectionality (Questions 1)
1) How would you describe yourself in terms of your race and/or ethnicity?
   a. How do you first identify, as Black or as a woman? Why?

2) How have you developed your intersecting identities as a Black woman in a White-male dominated environment like engineering/computer science?
   a. How have systems of oppression (i.e., overt racism, sexism, macro- and micro-aggressions overt racism, etc.) reshaped your identities as an engineering/computer science student?

3) Can you share an example of a time when you felt racially excluded in any of the STEM courses in your major?
   a. Walk me through it step-by step, describe what happened and reflect on it.

4) Now, let’s think about your intersectionality—intersecting identities as a Black woman. What role, do you feel being a Black woman has played in any discrimination you have faced in your program, if any?
a. Take me on a mini tour of a time when you may have experienced macro- or microaggressions due of your identity as a Black woman (i.e., “I felt this way,” or “I experienced this…”)

5) Let’s now think about your engineering/computer science major.
   a. Describe the gender and racial make-up of your peers and faculty in your classrooms.
   b. Do you share the same identity as these peers and faculty? How does this make you feel?

Systemic Factors (Questions 3)
1) Given that Black women are underrepresented in STEM fields, especially ECS, can you describe any role models on campus that help you connect with your identity as a Black woman? (Role models)

2) Have you ever felt like the token Black girl in your engineering/computer science classes? If so, how has the perception as a token by majority group influenced your academic focus and achievements? (Tokenism)

3) As an aspiring Black engineer/computer scientist, describe your feelings of belonging in your classes/major. (Feelings of belonging/isolation)

Closing Questions:
I would like to give you a final opportunity to help us examine these issues. Before I end today, is there anything that I missed? Do you have anything else to add at this time? Have you said everything that you wanted to say but did not get a chance to say? Have you shared everything that is significant about these interactions with me? If there’s anything else that you recall after our interview session, I invite you to share it by contacting me.

III. Post-Interview Session: Debriefing and Closing:
Thank you for participating in today’s interview session. I appreciate your taking the time and sharing your ideas and experiences with me with me. I also want to restate that what you have shared with me is confidential. No part of our discussion that includes names or other identifying information will be used in any report or document. Finally, I want to provide you with a chance to ask any questions that you might have about this interview. Do you have any questions at this time?